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PRINCIPAL CONTENTS.

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THE JOURNAL
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MINISTRY OF AGRICULTURE

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NOTES FOR THE MONTH.

Foot-and-Mouth Disease.

On 24th January outbreaks of Foot-and-Mouth Disease were confirmed in lairs at Newcastle, at Seaham Harbour (Durham) and at Hessle near Hull in the East Riding of Yorkshire. The affected cattle in the Newcastle outbreak had been exposed with others in Morpeth Market on 16th January and at Newcastle Market on 17th January. As other consequential outbreaks were therefore to be anticipated a wide area was scheduled, including the whole of Durham and a large part of Northumberland, in which movement of animals was prohibited. An area was also scheduled around Hull.

These cases proved to be the forerunners of the most widespread outbreak of Foot-and-Mouth Disease which this country has known since 1884. Up to Sunday, 19th February, no fewer than 787 outbreaks on separate premises were confirmed in the whole of Great Britain, and 65 other reports were under investigation. The confirmed outbreaks numbered 787, distributed, as shown in the following table, in 27 counties in England, 1 county in Wales, and 11 counties in Scotland :—

England and Wales.				*Scotland.*	
Bedfordshire	1	Norfolk	15	Berwickshire	2
Cambridge	2	Northumberland	30	Dumbarton	1
Cheshire	31	Nottinghamshire	13	Dumfries	1
Cumberland	4	Salop	1	Fifeshire	3
Derbyshire	5	Staffordshire	3	Forfarshire	8
Durham	69	Suffolk	4	Lanarkshire	7
Essex	7	Surrey	1	Linlithgow	1
Hants	1	Warwickshire	1	Midlothian	9
Kent	1	Westmorland	19	Perthshire	6
Lancashire	79	Yorkshire E.R.	117	Renfrewshire	14
Leicestershire	2	Yorkshire N.R.	70	Stirling	5
Kesteven	1	Yorkshire W.R.	230		
Lindsey	17	Denbighshire	1	Total	57
London	2				
Middlesex	3	Total	730		

(41783) P.14/35. 11,250. 3/22. M. & S.

The present policy of the Ministry in dealing with Foot-and-Mouth Disease is the "stamping out" policy, that is, the extermination of the virus of the disease by the immediate slaughter of affected animals, and of other animals which, owing to their direct contact with the former, are certain to become infected. As the virus of the disease can be carried long distances by the feet of other animals, or by the feet and clothes of persons, and even by birds or by the wind, the disposal of affected stock as promptly as possible is the most effective means of eradication. In pursuit of this policy the Ministry had up to 19th February authorised the slaughter of 17,249 cattle, 7,850 sheep, 6,788 pigs and 33 goats.

The origin of the outbreak is still obscure, but the evidence so far available points to the fact that many markets were infected before disease was reported to the Authorities. The following is a list of infected markets (ascertained up to 19th February) and the date when it appears diseased animals were exposed thereat:

England.			
Newcastle	14th Jan. 23rd Jan.	Stanford-le-Hope	27th Jan.
Hull	17th Jan. 23rd Jan.	Bradford	24th Jan.
Gateshead	24th Jan.	Otley	27th Jan.
Northallerton	25th Jan.	Malton	28th Jan.
York	26th Jan.	Leeds	24th Jan.
Wakefield	27th Jan.	Norwich	28th Jan. 4th Feb.
Doncaster	24th Jan.	Ipswich	30th Jan.
Worksop	25th Jan.	Sheffield	Uncertain.
Carlisle	21st Jan.	Islington (London)	31st Jan.
Kendal	23rd Jan.	*Scotland.*	
Manchester	27th Jan.	Berwick	27th or 28th Jan.
Chester	26th Jan.	Glasgow	25th Jan.
Crewe	23rd Jan.	Edinburgh	Date uncertain.
Market Drayton	25th Jan.	Stirling	26th Jan.
Stockton	25th Jan.	Dundee	31st Jan.
Darlington	23rd Jan.	Greenock	31st Jan.
Preston	27th Jan.	Paisley	30th Jan.
		Perth	20th Jan. 27th Jan.

Up to 19th February no fewer than 142 outbreaks had been traced directly to infection contracted at these markets, and inquiries with a view to tracing the chain of infection more completely are proceeding. It is also known that on 21st January a consignment of 44 cattle was shipped from Hull to Antwerp and that 5 of these animals on arrival at Antwerp showed lesions of Foot-and-Mouth Disease.

As soon as it became evident—on 30th January—that diseased animals must have been exposed at the above-mentioned markets,

restrictions on the movement of stock, which at first had been confined to the counties of Durham, Northumberland, Yorkshire and parts of Nottinghamshire and Lincolnshire, were extended to the whole of the North of England from the Scottish border to Staffordshire.

On 31st January disease was confirmed at Glasgow and at Gorgie market, Edinburgh. It appeared that the animals concerned in the Glasgow outbreak had passed through Glasgow market on 25th January. The Ministry thereupon as a precautionary measure applied control of movement over the whole of Scotland south of a line from Aberdeen to Dumbarton, and the wisdom of this step was proved by the subsequent outbreaks in the counties of Lanark, Renfrew, Stirling, Forfar, Perth, Dumbarton, Fife, Berwick and Dumfries. It was hoped that the above areas would include all centres to which the disease might have spread from the markets. This unhappily proved not to be the case, as on 2nd February disease appeared at Biggleswade in Bedfordshire, around which an area was at once scheduled, on 4th February at Rochford (Essex), and in Denbighshire, outside the north of England area. On Sunday morning, 5th February, disease was also confirmed in Norwich cattle market.

The position at Norwich market was specially difficult as several hundred animals were detained at the market at the time the disease was confirmed, and arrangements had to be made for the disposal of these as far as possible for slaughter locally. Others, for which no slaughtering accommodation was available, were licensed under special precautionary conditions direct to slaughterhouses in other towns. 20 trucks of cattle which were on their way south were held up at Chelmsford and dealt with there.

It was clear that there were other centres of which the Ministry was not yet aware, and after careful consideration it was decided on Sunday morning, 5th February, to place the whole of Great Britain under control of movement of animals by licence, and to prohibit the holding of markets of livestock except for immediate slaughter so that the meat supply should be maintained. The Order issued on that date divided Great Britain into five separate Scheduled Districts, namely:—(1) The N.-W. of Scotland; (2) the S.-E. of Scotland; (3) the N. of England; (4) the S.-E. of England; (5) the S.-W. of England, and Wales.

All movement of cattle, sheep, pigs or goats within these districts was prohibited except for necessary purposes and then by licence of the Local Authority Inspectors. The Order also prohibited movement from one of these Scheduled Areas to another,

except direct to a slaughterhouse by licence. The movement of any stock out of the most densely infected areas was entirely prohibited, *i.e.*, out of (*a*) Durham and the greater part of Northumberland; (*b*) the southern half of the West Riding of Yorkshire; (*c*) the East Riding of Yorkshire; and (*d*) Cheshire. Certain prohibited areas were also maintained around the most recent outlying infected centres.

This Order was communicated to every Local Authority and Chief Constable, as well as to the Ministry's Officers and to the Press on Sunday night, 5th February.

The work thrown upon both the indoor and outdoor staff of the Ministry, and in many instances also upon the Local Authorities, by this outbreak has been exceptionally heavy, necessitating the addition of a large number of temporary Inspectors for stock inspections, the arranging and supervision of slaughtering operations, the sale of salvageable carcasses and the disinfection of infected premises.

* * * * * *

Importation of Store Cattle.

IN reply to a question by Captain Fitzroy as to whether the Government had considered the Report of the Royal Commission on the embargo on Canadian cattle; and whether they proposed to make any alteration in the Diseases of Animals Act, 1894, Sir Arthur G. Boscawen (Minister of Agriculture) stated: "The Government have carefully considered the Report of the Royal Commission, but in view of the almost unanimous opinion of agriculturists of all classes in England and Wales that the removal of the embargo would seriously injure the industry, and of the fact that the Commission themselves report that it would have little effect on the price of meat, they do not propose to introduce legislation for the purpose of removing it."

In reply to supplementary questions, Sir A. G. Boscawen gave the following answers:—

"We have given consideration to opinion in Scotland, and there is very great diversity of opinion on this matter among agriculturists in Scotland."

"No Government is pledged to carry out all or any of the recommendations of a Royal Commission, which are the individual opinions of the Commissioners, and in this case even if we had accepted their conclusions they themselves say that they fully recognise that the opinion of Parliament may be a reason for some delay in taking action. Apart from that I

believe that in this matter certain pledges were given in 1917 at the Imperial Conference when this question, and a great many others, were under discussion, but, as I understand, the position which the Canadian Government most properly have always taken is that they do not wish to interfere in our home politics or home affairs, and that if we were convinced that the removing of the embargo was detrimental to our interests they would not press for it."

* * * * * *

Report on Acreage under Crops and Number of Live Stock in 1921.

FROM an agricultural point of view, the 4th June is a date of some interest as it is on this day that the agricultural returns of acreage and live stock have been collected annually for 56 years. Immediately the returns are complete the results for the whole of England and Wales are tabulated and issued—the results for last year being issued on 9th August. The Report now issued contains in addition to the totals for England and Wales the figures for the different counties, as well as the totals for Scotland and Ireland. Attention is drawn in the Report to the changes in the area of cultivated land and number of live stock in 1921, and some interesting figures are given showing the number of poultry on agricultural holdings over one acre in 1908, 1913 and 1921. Particulars are also given for the same years of the number of workers returned by the occupiers as employed on their holdings on 4th June.

This Report, which forms Part I of the Agricultural Statistics for 1921, can be obtained through any bookseller or directly from H.M. Stationery Office, Imperial House, Kingsway, W.C.2, and 28, Abingdon Street, S.W.1.

* * * * * *

Conciliation Committees in Agriculture.

OF the 32 Conciliation Committee agreements in operation on the 22nd February, 8 are for periods up to and including the hay and corn harvest and it is clear that the advantages of long-term agreements are becoming more generally appreciated.

The hours question appears to be causing difficulty in some areas. The new agreements of the Shropshire and Isle of Ely Committees are especially interesting as indicating how this question has been satisfactorily settled in those areas. In the former area where agreement has been reached for a guaranteed week of 48 hours in February and 50 hours from March to Sep-

tember a condition of the agreement is that employers and workers agree to encourage the working of longer hours when necessary. In the case of the Isle of Ely, although the wages agreement operates only up to the 31st May next, it has at the same time been decided that the working week during the summer months shall consist of 51 hours, while for next winter the hours shall be 48 per week.

On the question of the weekly half-holiday there has been very little difficulty on the Committees, and in general it has been agreed that where the workers desire the half-holiday employers should facilitate the arrangement of the working hours accordingly.

Particulars of agreements relating to adult male workers, in force on the 20th January, have already been published. Further agreements reached up to 22nd February are shown in the following table :—

Area.	*Period.*	*Wages.*	*Hours per week.*
Cornwall - -	Up to 28th Feb., 1922	34/-	—
Derby - - -	„ 31st March, „	36/-. Weekday overtime. 8d. per hour. Sunday employment, 11d. per hour.	54
Devon - - -	„ 25th „ „	34/-	50
„ - - -	„ 29th Sept. „	32/-	50
Dorset - - -	„ 28th Feb. „	32/-. Carters, cowmen and Shepherds, 8d. per hour up to 60 hours. Over 60 hours, 10d. per hour.	48
„ - - -	„ 29th April, „	32/-. Carters, cowmen and shepherds, 7½d. per hour up to 60 hours. Over 60 hours, 9½d per hour.	51
Hertfordshire -	„ 3rd March, „	8d. per hour. Guaranteed week of 48 hours.	—
Lancashire			
Southern area -	„ 31st „ „	45/-. Rates for other workers in proportion.	Customary hours.
Northern area -	„ 31st „ „	42/6	Customary hours.
Eastern area -	„ 31st „ „	50/-	Customary hours.

Area.	*Period.*	*Wages.*	*Hours per week.*
Middlesex S.	- Up to 2nd Sep., 1922	35/5. Guaranteed week of 48 hours. Weekday overtime, 10d. per hour. Sunday employment, 11d. per hour. Carters, stockmen, &c., 8½d. per hour up to 60 hours. Weekday overtime, 10d. per hour. Sunday employment, 11d. per hour.	50
Rutland - -	„ 28th Feb., „	32/-	48
	„ 28th Oct., „	32/-. Rates to vary 1/- for every change of 6 points in cost of living.	50
Shropshire - -	„ 6th March, „	8d. per hour. Guaranteed week of 48 hours. Sunday employment, 10d. per hour.	
„ - -	„ 30th Sep., „	7½d. per hour. Guaranteed week of 50 hours. Sunday employment, 10d. per hour.	
Somerset - -	„ 28th Feb., „	33/-	50
- -	„ 30th April, „	32/-	50
Stafford - -	„ 29th „ „	8d. per hour. Guaranteed week of 50 hours. Sunday employment, 10d. per hour.	—
Surrey* - -	„ 25th March, „ (Male workers from 21 to 65 years)	33/4. Overtime, 9d. per hour. Carters, cowmen and shepherds, and time worked between 50 and 60 hours per week, 8d. per hour, and all time worked by these classes in excess of 60 hours, 9d. per hour.	50
Sussex E. -	- Up to 31st March, 1922	31/-. Overtime, 8d. per hour.	52
Warwick* - -	„ „ 3rd „ „	Able-bodied male workers, 31/-. Guaranteed week of 48 hours. Overtime, 8½d. per hour.	48
	„ „ 6th Oct., „	Able-bodied male workers 31/-. Guaranteed week of 50 hours. Overtime, 8d. per hour.	50

* Agreement confirmed by the Minister.

Area.	*Period.*	*Wages.*	*Hours per week.*
Warwick—*contd.*	Up to 6th Oct., 1922	14 to 15 years,	33½ % of wages fixed for men of 21 and over.
		15 „ 16 „	40 „ „ „ „
		16 „ 17 „	50 „ „ „ „
		17 „ 18 „	60 „ „ „ „
		18 „ 19 „	70 „ „ „ „
		19 „ 20 „	80 „ „ „ „
		20 „ 21 „	90 „ „ „ „
Merioneth and Montgomery -	„ „ 28th Feb., „	35/- or 38/-	50 56

The Isle of Ely Committee have arrived at an agreement for wages from 1st March (when their existing agreement expires) up to 31st May, which, in accordance with the Committee's application, has been confirmed by the Minister. The agreement provides as follows:—

(a) Male Workers aged 18 and over, employed as Horsemen or Milkmen:—

Years of Age and Wages.	
21 and over	40/6
20 and under 21	37/9
19 „ „ 20	35/6
18 „ „ 19	34/3

For a week comprising the hours necessary for the performance of the customary duties of these classes of workers.

(b) All other male workers employed in agriculture:—

Years of Age	*Weekly Wages for a week of 51 hours.*	*Overtime rates for all time in excess of 51 hours per week.*
21 and over	31/-	... 8½d.
20 and under 21	28/9	... 8d.
19 „ „ 20	27/-	... 7½d.
18 „ „ 19	25/9	... 7d.
17 „ „ 18	20/6	... 5½d.
16 „ „ 17	16/3	... 5d.
15 „ „ 16	13/3	... 4½d.
14 „ „ 15	10/3	... 3d.
Under 14	7/3	... 2½d.

That the working week for summer months (*i.e.*, from the first Monday in March to the last Saturday in October) shall consist of 51 hours, and for next winter (*i.e.*, for the period other than the summer months) shall consist of 48 hours.

While no definite agreement is made regarding Saturday half-day, the employers will not put any obstacles in the way of farmers arranging with their workmen for a Saturday half-day after 51 hours have been worked, and this clause is to be carried out in a reasonable spirit.

Further details of the agreements in each area can be obtained on application to the Ministry.

* * * * * *

The Agricultural Index Number.

PRICES during January were on the average again slightly lower than in the previous month, being only about 79 per cent. above the pre-War level as compared with 82 per cent. in December. The following table traces the course of prices of agricultural produce monthly from the beginning of 1919 down

to the present time, the figures representing the percentage increases in value as compared with the average of the three years 1911-13 :—

Month.	1919. *Per cent.*	1920. *Per cent.*	1921. *Per cent.*	1922. *Per cent.*
January	148	213	186	79
February	150	205	172	—
March	150	199	158	—
April	153	199	141	—
May	132	169	112	—
June	128	164	102	—
July	141	174	100	—
August	138	177	116	—
September... ...	148	181	105	—
October	166	191	90	—
November... ...	182	197	84	—
December... ...	207	194	82	—

Wheat and oats were practically unchanged in value in January as compared with December, 1921, but barley was again cheaper, averaging about 50 per cent. above the pre-War price. Fat and store cattle were somewhat cheaper, and dairy cows decidedly so, averaging about £39 per head or about 89 per cent. above the 1911-13 price compared with £42 and 104 per cent. in the previous month; dairy cows, however, remain the dearest class of stock in comparison with pre-War days. Fat and store sheep appreciated in value, a steady rise continuing throughout the month, while store pigs were also dearer, although fat pigs showed little change. Eggs again experienced a sharp decline in price, which was, however, recovered to some extent during the latter part of the month. Dairy produce generally sold at lower rates, butter especially falling in price, due probably to the recent substantial reductions in the price of imported butter. The average price of milk delivered under contract into large towns was in January about 157 per cent. above the annual price, and roughly double the average winter price in pre-War days. Hay showed little alteration, while potatoes met a rather better trade at firmer values.

Among the commodities purchased by the farmer, the chief reductions have been in milling offals and in the phosphatic manures. Other feeding stuffs are also generally cheaper, linseed cake exceptionally showing a slight rise. A slight fall in the price of nitrate of soda was off-set by a corresponding increase in the cost of sulphate of ammonia.

* * * * * *

Imperial Fruit Show, 1922.

AT this period of the year Fruit Show Committees are generally meeting to make arrangements for the holding of Fruit Shows throughout the country. All fruit shows where the best of fruit is exhibited packed in an approved manner, are naturally of an educative kind, but the education can be directed to appeal to different classes of people. It may be directed towards affording stimulation and information for the producers or it may be intended to arouse the interest of the consumers.

There is certainly a need for both types of show, for no one would say that the systems adopted by the producers of fruit in this country are of a sufficiently high standard to admit of no improvement, while the arguments for the education of the consumer are possibly even greater, since at the present time large numbers of people in this country know but little of fruit and are unaware of its dietetic value. Wider knowledge of the facts would increase their interest and stimulate the demand for good varieties of fruit. Shows held in the producing areas are of great interest to the local growers, and certainly meet the first point. In past years the fruit shows organised by The West Midland Counties Commercial Fruit Show Association, The Eastern Counties Commercial Fruit Show Association, and The Kent Commercial Fruit Show Association have had a very beneficial effect amongst the fruit growers in the respective areas, and there is a distinct need for the growers in other areas, such as the West of England to follow their example in this direction. These local shows are organised by the growers themselves, and the cost involved is but small.

The growers, however, cannot afford to leave matters at that point, because they depend on the sale of their commodities, and it is to their financial interest to stimulate a demand for these commodities amongst the consuming population of the country. For this reason they should follow the example of the motor and other industries, and arrange for shows in the large centres of population such as London, Birmingham, Manchester, Leeds, Liverpool. In order to attract the public these shows must be organised on an extensive scale and be backed by extensive advertising and propaganda. The cost involved in organising shows of this kind is out of all proportion to the cost of the local shows, but they are vitally necessary, and the financial support might be forthcoming by the friendly co-operation of all the Federations of the Associations within the horticultural industry. Co-operation at all times is difficult, and at present the Federations are not prepared to bear the financial responsibility.

The Directors of *The Daily Mail*, however, offered to organise and be financially responsible for another Imperial Fruit Show to be held next autumn, similar to that which was held in 1921, but slightly modified in character, provided always that the bulk of the industry pledges its support and co-operation. The Ministry and the industry, by means of an Advisory Committee, which will be representative of the various sections of the industry of this country and of other parts of the Empire, will co-operate with *The Daily Mail*, to which all matters of finance and general organisation will be left. Decisions on technical matters, including the drawing up of the Regulations, the Classes and the selection of Judges will be in the hands of the Committee. This should be a sufficient indication that the interests of the industry are safe-guarded. The great point for the industry to realise is that such shows will greatly aid the industry, by educating the grower and increasing the demand for fruit, and by stimulating the consumers' interest as to the dietary importance of fruit and its by-products.

The proposed show will have classes affording competition between home producers and those from overseas, and should not be to the disadvantage of the home industry. The overseas grower, to overcome the handicap of distance from his market, has been compelled to adopt systems of grading and packing of fruit in advance of those generally adopted by the home industry, and study of their methods is of considerable advantage to the home producers. This friendly competition with the peoples of other parts of the British Empire should be welcomed by the home industry.

In the organisation of a big show which is both National and Imperial, and where sections of the industry are co-operating that normally have competing interests, it is naturally an important and a difficult matter to secure agreement. Fruit growers may, however, be assured that the composition of the Advisory Committee suggests there is no likelihood of any important matter being decided in a manner detrimental to their interests.

The offer of *The Daily Mail* to organise and finance the show, in co-operation with the Ministry and the Advisory Committee, is now under the consideration of the fruit-growing industry, and the Ministry asks fruit growers, and all others interested in fruit, to give their support to the undertaking for the good of the whole industry.

* * * * * *

YOUNG FARMERS' CLUBS.

F. E. BUSSY,
Director, Associated Newspapers, Ltd.

INCREASED interest is being taken by both agriculturists and the general public in the Young Farmers' Club movement, which is being vigorously promoted by *The Daily Mail* and several big industrial concerns in the country.

It is the purpose of this article briefly to explain what the Young Farmers' Club is and does, and the results which have been attained in England and also in the United States of America, from which country the movement hails.

Given some public-spirited local resident who will bear the very small financial burden which the establishment of a Club imposes, and two or three energetic helpers (who will act in the capacity of Advisory Committee), the formation of a Club is a very easy matter. Having decided what kind of stock or produce can most advantageously be raised, having regard to local conditions, the following is the line of action taken :—

The Advisory Committee call together the children and parents in the district where the Club is to be formed (and it is desirable that the children should not be drawn from a very wide area), and outline the scheme to them. Having interested from ten to twenty children, ranging between 10 and 18 years, as Club members, they are instructed to appoint their own officers, *i.e.*, Chairman, Vice-Chairman, Secretary and Treasurer. The duties of these officers are explained to them by the Advisory Committee, and from this point the Club is left to conduct its own business and carry on its own meetings.

Associate members, for whom there is no age limit, are elected on passing ballot of the Club members. This entitles them to attend lectures and take part in discussions, but gives them no power to vote or enter for competitions. Associate members pay a subscription determined by the Club members. In practice, it usually happens that parents desire to become associate members, and the Club funds benefit accordingly.

The children meet once weekly or fortnightly, and are given a lecture or hold a discussion on the particular project in which they are interested. Lecturers can readily be obtained for this purpose. The Ministry of Agriculture has promised that its local officers and those of Agricultural Universities and Colleges will be available for giving such lectures, while the most

prominent professional stock-raisers readily respond to the invitations of Clubs to lecture.

In almost every district where any particular kind of stock or crop is raised, there are local Associations whose leading members are willing to give instruction.

On occasions when no lecturer is available the children read and discuss a chapter from one of the standard agricultural or horticultural books. Numerous pamphlets and bulletins are obtainable from the bodies before mentioned, and from the Colleges.

When the preliminary instructions have been given the children are called together and ballot for the animals they are to keep. These animals, which are purchased by the founder of the Club, are scored on points before they are handed over to their youthful custodians, and a note of hand, bearing no interest, and signed by the parent, is taken in exchange.

At the end of a period, which will be determined according to the nature of the stock (in most cases it is one year), and during which the Advisory Committee will pay periodical visits to the children's homes to see that the animals are properly looked after, and to withdraw those which are not, the stock will be brought together and re-judged on points. Small prizes will then be awarded to the children whose animals have made the greatest progress while in their care, and other small prizes for the best stock records, showing actual cost of feed and labour, and weight of feed given to animals, etc., that the children have kept in specially prepared books.

The animals are then put up for auction and sold. Ten per cent. of the price realised is paid into the funds of the Club, the value of the animal at the date it was handed to the child is returned to the founder of the Club, and the balance is handed to the child as compensation for feeding and a reward for industry. The child can buy in the animal if so desired, by paying the original value, plus the 10 per cent. which goes to the Club Fund.

From this it will be seen that the only expense which falls upon the founder of the Club is the small sum involved in the prize money (which should never exceed £20), and the interest on the capital value of the stock for twelve months. The scheme varies as to detail according to the nature of the stock or crop to be raised.

The foregoing is the general outline which should be applicable to practically all *stock*-raising Clubs.

With crops the arrangement must vary slightly. Either the donor of the Club is asked to provide a plot of land and the necessary fruit trees, to take by way of rental the sum of 3s. a year (for about a 4-perch allotment) from the child, or the children use a measured plot of ground on their own farms or gardens. Prizes are awarded for the best cultivated plots and for the best kept records, showing cost of fertilizers, etc., and the best kept tools. All surplus produce raised on the plot is marketed through the Club, who credit the member responsible with the value, less 10 per cent. contribution to the Club fund. At the prize distribution at the end of the season, the net proceeds are returned to the members.

The founder of the Club provides all the necessary tools against a note of hand for their value from the parent, and the repayment of the cost of tools becomes a first charge on the sale of produce. In some cases it is possible to allow members to carry on the Club work in their own gardens. When this is done the gardens are handicapped according to their size and degree of cultivation at the start of the contest. Where young fruit orchards are planted for the purposes of a Club, the children are instructed in inter-cropping vegetables while the trees are coming to maturity. Alternatively, when the person who is promoting a Club does not himself rear or raise the stock to be issued to the children, does not want to buy it, and (or) is not prepared to advance the necessary capital free of interest,—then the advance is made to the Club direct by the promoter at an agreed rate of interest, and the Club holds the notes of hand from the children's parents. In such a case repayment of capital and interest is made a first charge upon the sale of produce or stock. The Advisory Committee, with the assistance of the local Divisional Inspector, supervises the purchase of the stock most suitable to the locality.

Such is an outline of the formation and working of the Clubs. Their advantages are obvious.

They bring the agricultural college to the door of the youngsters by means of lectures and demonstrations, and enable them to put into practice the facts obtained from scientific books, and the bulletins of the world's leading agricultural colleges.

Scientific research is continuously going on in agriculture, and the Young Farmers' Club enables the rising generation of agriculturists to take immediate advantage of laboratory discoveries by their practical application.

All the time the Club is dignifying the farmer's vocation,

by demonstrating to the young people that labour intelligently applied to farming brings satisfactory returns.

The fact that the Club members conduct all their own Club business on their own initiative, instructs them in the proper conduct of public business, and prepares them for leadership in public life. It encourages them to speak in public, and this develops self-reliance and self-confidence.

Morally, the scheme achieves even more. It is often complained that boys and girls in rural communities have no outlet for their boundless mental and physical energy. The Young Farmers' Club gives them a fascinating and inspiring occupation, and provides them with a definite purpose at an important period of their lives. They are drawn together by the Club, and thus isolation is diminished, and budding talent for leadership is developed. The " mute inglorious Miltons " are taught to express themselves, and their eyes are drawn to a wider horizon of endeavour and achievement.

Love of home and country, and loyalty and respect for constituted authority are first-fruits of the teaching of the Clubs, and they assist in the development of a fine spirit of co-operation in the community.

In America the movement has reached tremendous proportions. Of students taking the regular course in agriculture and home economics in the State Colleges in 1920 over 1,800 were boys and girls who had been members of the Clubs, while over 3,300 club boys and girls took short courses at the colleges, 730 having won scholarships through their club work.

One of the great merits of the movement as manifested in America is that it is splendidly resultful as propaganda for pure-bred stock. It is a matter of actual record that during 1920 5,000 farmers were led to replace poor-bred pigs with pure-breds as a result of the pig club work of the clubs.

In 1920, 3,000 poultry-club members in the Northern and Western States introduced 38,000 pure-bred fowls on their home farms and raised 155,000 chickens.

In the same year there were over 216,000 American boys and girls between the ages of 10 and 18 years engaged in the work of 14,000 clubs. The actual financial output for the year was over $4,600,000, which is eloquent evidence of the sound business basis of the movement.

In the Northern and Western States of America the club work is recognised as of such importance that 200 counties employ county club agents to co-operate with districts in

developing demonstration work. In such counties annual appropriations of from $3,000 to $4,000 are made to carry on the work.

In England the movement is, of course, in its infancy, but it shows signs of lusty growth. There are existing and in course of formation over a score of Young Farmers' Clubs in England.

The Daily Mail is responsible for Poultry, Bee, Dual-purpose Rabbit, and Horticultural Clubs at Welwyn Garden City. These have been in existence for periods ranging from 12 months in the case of the Bee Club to a month in the case of the Horticultural Club.

The United Dairies, Ltd., are the sponsors of Calf Clubs at Hemyock, Devon; Kingsclere, Berkshire; and Loughborough, Derbyshire: the oldest club being the Hemyock Calf Club which has just celebrated its first birthday.

Messrs. C. & T. Harris, of Calne, Wilts, have organised a Pig Club at Wootton Bassett, Wilts, and Mr. R. G. Heaton, a well-known stock breeder, is the patron of another Pig Club at Northaw, Potters Bar, Herts. At Northaw a Poultry Club is in process of formation under the guidance of Mr. Tucker.

Ten clubs dealing with a variety of stock and produce are in course of preliminary organisation amongst the children of employees of a large industrial firm in the North of England and North Wales.

* * * * * *

THE NATIONAL INSTITUTE OF AGRICULTURAL BOTANY.

W. H. PARKER, M.C., M.A.,
Director of the National Institute of Agricultural Botany.

IN several of the recent issues of this *Journal* passing reference has been made to the National Institute of Agricultural Botany. It is now proposed to give a full description of its organisation and functions, for its headquarters are completed and opened, it has already been accorded the honour of a visit from Their Majesties the King and Queen and Princess Mary, and the work for which it was founded is now going forward.

Inception of the Institute.—England may always feel proud that, through the agency of Sir John Lawes and Sir Joseph Gilbert, it was she who took the initial step in agricultural

research. Rothamsted has been the model on which all similar research stations throughout the world have based their constitutions, and has never lost the lead which these two great men afforded it in the investigation of problems connected with the soil and its manuring. Thus it is only just that this country should now be able to recover from abroad a portion of the debt thus created.

England had long been satisfied to rely on her acknowledged lead in soil and manurial science to maintain her position as the producer of the highest yields per acre of any country in the world. Naturally a degree of improvement had gradually taken place in the productivity of the crops themselves, but until a comparatively recent date work on these lines was left entirely to the competitive efforts of the seed-trade or the more or less chance discoveries of amateurs. New varieties were thrown on to the market to sink or swim as fortune dictated—it could not be otherwise, for yield testing is even now in its infancy. Yet at this early stage the one definite fact emerges that only trials carried out on a scale beyond the capacity of any private undertaking can produce results on which reliance can be placed. The value of varieties was necessarily determined by purchasers who established, by the costly system of trial and error, what was, and what was not, worth retaining in cultivation.

Such, in fact, was the position in England when the Great War broke out. With the War came the realisation that the life of the nation depended on its crops, and that every possible method of increasing the food production of the country must be exploited if it were to survive the ordeal.

Objects and Policy.—Sir Lawrence Weaver, then in the Food Production Department of the Ministry of Agriculture, thought that the most hopeful line of attack on this problem was to concentrate on the improvement of the national seed supply. Not only did he contemplate insuring an adequate supply of pure healthy seed, but he wished to provide a stimulus which should induce increased production and rapid distribution of improved varieties of our agricultural plants, so that the land should be used to the greatest possible advantage. The result was his scheme for a National Institute of Agricultural Botany.

With such an aim in view it is natural that he should turn for guidance to that great Swedish station—Svalöf—where work of this kind had been in progress since 1886. The conditions were not parallel, but the line of intersection lay some

distance along the path on which it seemed that the new Institute should travel.

The Swedish Society for the Improvement of Seeds had come into existence at a time when elsewhere no attempt whatever was being made towards crop improvement; its aims were proprietary, for it was constituted solely with a view to supplying its own members with superior strains of farm crops which it proposed to obtain by methods of selection. It existed for production rather than distribution, and when, later, distribution was introduced as a new development, the Company which was formed for this purpose worked primarily for the benefit of its shareholders, and, in effect, swamped any competition likely to prejudice its prosperity.

The functions of the National Institute of Agricultural Botany were designed with quite a different object. It was emphatically "National," and it set out to encourage every effort towards plant improvement, no matter from what source that effort originated; only itself embarking on such undertakings as would assist others, whether seedsmen, scientists or farmers, to advance in the direction of improved output, ensuring to the fruits of such endeavours a more speedy and profitable recognition and use. Its very constitution is proof of its catholicity, for members of the Council are nominated by the following bodies:—The Ministry of Agriculture, Cambrige University, Oxford University, The Agricultural Seed Trade Association, The National Association of Corn and Agricultural Merchants, The National Association of British and Irish Millers, The Royal Agricultural Society of England, The National Farmers' Union, with the addition of members to be nominated by the Fellows, concerning whom more will be said at the end of this article.

From the first it was obvious that plant-breeding was outside the Institute's functions, for the rediscovery of Mendel's papers had already given an unprecedented impetus to this essential foundation of the success of the undertaking, turning it from a game of chance into a science. What was now required was an outlet from the research station to the market, but designed in such a manner that egress would only be conceded to productions of proved merit. Thus, in relation to new varieties, the Institute took as its basic principles "test" and "multiplication," at the same time making provision for a reasonable profit to the producer, who hitherto had been the smallest participant in the fruits of his effort.

FIG. 1.—The National Institute of Agricultural Botany.

FIG. 2.—Room for Examination of Seeds for Purity.

As the scheme developed its basis broadened. The Ministry of Agriculture proposed that since this new Institute existed with the object of seed improvement, all seed problems, including potato "seed," should come within its scope. To it was, therefore, handed over the administration of the Official Seed Testing Station, which had recently been set up in the Food Production Department. It was further arranged that the Institute should be entrusted with the growing of the potatoes entered for the annual trials for immunity to Wart Disease, the Ministry retaining the responsibility for pronouncement of immunity and the certification of varieties. Owing to this delegation of functions the Institute became a semi-official body.

Finance.—*Capital.*—That there was a demand for such an undertaking is evident from the nature of the response which resulted from the founder's appeal for funds with which to give shape to the conception. With the assistance of his fellow members on the Council £44,870 was soon accumulated, including the value of the gift by Mr. Fred Hiam of a 344 acre farm (since re-named "The Hiam Farm") near St. Ives, Huntingdonshire. Of this sum no less than £23,350 was derived from the Seed Trade and the Farming Industry. The whole of this amount was earmarked for the Institute's Capital Fund.

The Development Commission was approached in 1916 with a view to obtaining a grant for building the Official Seed Testing Station and a loan for the other activities of the Institute. Its final recommendations to the Treasury were accepted in November, 1919, and a grant of £25,350 and loans amounting to £21,568, making a total of £46,918, were sanctioned.

Maintenance.—Sanction was also given to the principle of an annual grant equivalent to two-thirds of approved expenditure on salaries, upkeep, etc., until such time as the Institute's sale of its products shall have put it on a self-supporting basis. The remaining third has to be made up by private subscriptions.

The Testing of Seeds being a public service, the whole cost of maintenance of the Official Seed Testing Station is borne on the Ministry's Vote, and is met out of public funds.

For the Institute's work in connection with the Potato Immunity Trials, the Ministry provides two-thirds of the salaries of the Superintendent of the Station and of his assistant, and £100 for each acre occupied by the Immunity Trials, in addition to the repayment of certain other items of expenditure. The remainder of the cost of operating the Station falls on the general funds of the Institute.

Staff.—The difference in financial treatment outlined above marks out the three Branches into which the Institute is divided. At the head of the whole undertaking (under the Council) is the Director who has as his immediate assistants the Secretary and the Accountant. The Branches are as follows:—

(1) The Crop Improvement Branch, under the personal charge of the Director.
(2) The Official Seed Testing Station, under Mr. C. B. Saunders, as Chief Officer.
(3) The Potato Testing Station at Ormskirk, Lancs., under Mr. H. Bryan, Superintendent of Potato Trials.

The staff of the Institute (apart from farm labour) in the three branches consists, in all, of 55 persons.

The work of each of the above branches is carried on under the general supervision of a Committee of the Council composed of experts in the several directions in which each has its sphere of activity. The activities of the several branches are described below.

Property in Land.—The properties of the Institute are as follows:—

The Headquarters Trial Ground, consisting of 36 acres of arable land on the Huntingdon Road, Cambridge, on a portion of which the Headquarters Buildings have been erected.

The Hiam Farm, St. Ives, mentioned above, which has been enlarged by the purchase of a further 20 acres, making 354 acres in all, which will be devoted principally to the growing on of cereals for seed.

The Potato Testing Station, Ormskirk, Lancashire, consisting of a farm-house, an office, and 39 acres of rich market-garden land.

The Headquarters Buildings.—The decision of the Council that the Headquarters of the Institute should be established at Cambridge was based on two considerations, (1) that a situation in the centre of an agricultural district was essential, and (2) that the locality should be one in which agricultural research, and particularly plant-breeding, was already thriving. Cambridge was the obvious place, and a site was purchased ideally situated immediately opposite the University Farm, and within a quarter of a mile of the farm occupied by Professor Biffen's Plant Breeding Institute.

The planning of the buildings was entrusted to Mr. P. Morley Horder, and two Committees—the first accompanied by the Architect—visited Svalöf, and all the more important Continental Seed Testing Stations before the final plans were drawn up. The need for economy precluded anything but the plainest design, and all ornamental features were rigidly

excluded. At the same time no trouble was spared which would make for working efficiency, and the result has been the provision of the best-found Station at present in existence.

As it stands, it is a two-storied building with a hipped mansard roof which allows space for an attic floor. It is constructed of local brick of varied shades, and consists of a central block, flanked on either side by projecting wings, forming an open court.

It is of interest to note that the whole of the main block is devoted to Seed Testing. On the ground floor, facing south, are the offices of the Seed Testing Station, in one of which samples are received, and from the other, reports of the tests are sent out. The office of the Chief Officer is centrally situated on the first floor, and the office above, on the attic floor, is occupied by the Principal Seed Analyst. The work of the Station is divided among four Sections—Vegetables and Cereals on the ground floor with Grasses and Clovers above. Each Section has its large laboratory for purity examinations, a room for the Head of Section (with a window looking into the purity room), and a smaller laboratory fitted with incubators in which germination tests are made. There is an additional clover germination room on the first floor, and the large laboratory on the attic floor is fitted with incubators of a special type—Copenhagen tanks—used principally for germination tests of the seeds of smaller grasses; also on the attic floor are the research laboratory, studio, dark-room, and store-room.

The ground floor of the west wing contains the offices of the Director, Secretary and Accountant of the Institute, and is therefore the centre of all the Institute's activities. From here also the work of the Crop Improvement Branch is controlled. On the first floor of this wing is the Council Room, the walls of which consist of panelled presses in cypress which already contain the nucleus of a reference library of books and pamphlets on subjects relating to the work of the Institute. The upper panels are gradually being replaced by portraits of Members of the Council and benefactors of the Institute.

On the first floor also are the Librarian's Room, Committee Room and office of the Manager of Field Plots.

The west wing consists of a Staff dining-room and kitchens on the ground floor with flats for members of the staff above.

A small existing farmhouse is occupied by the Secretary of the Institute. The adjacent farm buildings, and the remainder of the

Headquarter Trial Ground (some 30 acres) are to be devoted to the work of the Crop Improvement Branch. At a later date it is proposed to erect a seed-cleaning plant near the farm buildings.

The Crop Improvement Branch.—The future scope of this portion of the Institute's work is only limited by the question of finance. Among the diverse problems which come within its legitimate scope the following are the most outstanding:—Yield trials; quality tests; the introduction of new varieties and species; the study of varieties and strains with a view to the supplying of stocks suitable for the various conditions of soil and climate of the country, and by this means, possibly, the provision of material rendering a profitable return for the growing of crops hitherto considered unsuited to specific districts; the study of problems of seed-growing and retention of purity of stocks; seed-storage problems; the testing of varieties and strains for resistance to disease and insect attack; synonymity and other questions. At present it has only been found possible to begin work on the more pressing of these matters.

To perform its functions it is essential that the Institute shall only assist in the distribution of varieties which have proved their superiority in some desirable characteristic over those already in cultivation. Not only does this hold good in the case of varieties distributed through the Institute, but encouragement will also be given to worthy productions from other sources. At the present time, high yielding capacity is of paramount importance, and, for this reason the Institute is devoting much of its attention to yield testing on a field scale, cereals being the first group to be dealt with. To obtain results of more than local value the Institute is endeavouring to establish relations with institutions or individuals in the principal agricultural districts with a view to their co-operation in the conduct of field-trials, on a fixed plan, of the crops of special interest to their own areas. Varieties are to undergo a three years' trial, the first year on one of the Institute's properties in order to eliminate the effects of previous cultivation and climatic conditions, the two succeeding years ("full trials") simultaneously at several stations. Varieties of established merit serve as standards, and a new system of alternating strips of standard and new varieties, which has been proved to give unprecedented accuracy of result, is employed throughout. The trials are open to all who undertake to withhold their entries from the market until after the publication of the results of the third year of the trials, and who agree to defray their quota of the costs. Stocks are only eligible on

evidence that they are genuine novelties obtained by hybridisation or selection, and that there is reason to anticipate that they are superior to those already in cultivation.

Series of barleys and winter oats have already reached the "Full trial" stage, and it is anticipated that wheat and spring oats will be dealt with in the coming season.

Under specified conditions the Institute will undertake to distribute stocks which have proved their value in these trials, sharing profits with the producers. It has already the option on all productions of Professor Biffen's Plant Breeding Institute, and there is reason to believe that many other institutions and individuals will avail themselves of the facilities offered. The proposed seed-cleaning plant will be required to deal with these stocks, and plans have already been prepared.

Apart from this work, collections are being made of (1) Plants from abroad which might be of value under English conditions; (2) Old varieties in danger of extinction; (3). Reference collections of established modern varieties. Plants other than cereals are included in these collections. In view of the trend of present agricultural conditions, the investigation of forage crops will not be ignored.

The Official Seed Testing Station.—Seed testing is considered by those lacking technical knowledge to be a simple process, little do they realise the fine points involved even in the routine work of a Station which undertakes to issue reliable reports on samples of any kind of seeds which it may please the public to submit for test. The technique of testing requires constant revision, and, this must always be the case, for the methods of testing are necessarily arbitrary owing to the impossibility of even an approximation to the conditions for which the test is intended to furnish information. The farmer knows by experience the correct sowing time for the production of the most favourable results; the Station's tests must be completed and the reports sent out some time before this date. Thus, what would otherwise be the rational method of testing—in small field plots—is precluded. Indoor testing is the necessary alternative, for only thus can temperature, "seed-bed" and water supply be controlled: but what control should be exercised? Even a cursory study of the extremes of soil, climate and rainfall to be found even in England and Wales shows how impossible it is to devise a test which will represent "natural

conditions." The ideal is to supply to each seed the best possible opportunity for germination; for it is found that the higher the germination under the best conditions, the better the result under those of the field. Seeds, however, are capricious, and although it is easy to adopt the best possible conditions as a standard, each species, and, in many cases, each variety has its own special requirements which must be satisfied before it will put forth its best endeavours; and each necessitates separate study.

Quite apart from the routine work, there are, in addition, innumerable other problems which demand attention—such as the identification of diseases; the determination of the value of "hard seed" in clover; the survival value of split seed; the determination by prevalent weed seeds of place of origin of samples; the value of rapid germination as an indication of vigour; the identification of Crucifers—and many more. Enough has, however, been said to show that the testing of seeds is a highly technical subject, worthy of the position which it holds in the work of the Institute.

The Station, from 1st August, 1920, to 31st July, 1921, issued reports on the following samples:—

Grasses	3,238
Clovers	5,198
Vegetables, Roots, etc.	6,946
Cereals and Pulses	8,044
Forest Trees	151
	23,577

As far as can be judged, an increase of 6 per cent. on these figures is to be anticipated in the present year.

The Potato Testing Station.—The control of a disease for which there is no known cure is a problem which requires very special measures. If, in addition, the spores of that disease can establish themselves in a locality and survive for years without visible means of subsistence, ready at any moment to attack those susceptible to their onslaughts; and if these spores can be carried from place to place by agents having no relation to their chosen hosts, the difficulties would appear well nigh insuperable. All this is true of wart disease of potatoes, yet, in spite of it, healthy and remunerative crops are being grown in the infected areas.

Immunity Trials.—Almost from the time that this scourge first received serious attention in England, it was noticed that certain varieties were immune from its onslaughts. Mr. John Snell, an Inspector of the Ministry of Agriculture, appreciated the latent possibilities of this discovery, and, while stationed at Ormskirk established, with purely local support, the Immunity Trials which are now world-famed. Before his death in 1920 the Ministry had recognised the value of the work and was providing the necessary funds. The trials had, however, outgrown the famous Workhouse Ground, and were transferred to the 40-acre farm acquired by the Institute, where in 1922 they consisted of 778 stocks, occupying 3½ acres divided into small plots.

After Snell's death his original supporters, the Ormskirk Potato Society, raised a fund for the perpetuation of his memory; the memorial took the form of a portrait which now hangs in the Potato Testing Station, and a medal, to be awarded annually to persons whose work shall have helped to improve potato husbandry either by scientific, administrative or commercial means. The responsibility for the award of this medal has been delegated to the Institute, and the first medal was awarded in December last to Mr. Ezra Miles, well known for his breeding work.

New Varieties.—In addition to the conduct of the Immunity Trials, the Institute is performing another service of which Snell was the originator. Annually from 1913 till his death, a report was published giving his considered opinion as to the right to be considered as novelties of so-called new varieties sent to the Station for Immunity Test. An Annual Report is now compiled by a Committee appointed by the Institute—the Potato Synonym Committee under the chairmanship of Dr. Salaman—composed of some of the greatest experts, who investigate every plot grown at the Station and record their decisions. The Report, before publication, is submitted to a Conference composed of leading potato raisers and merchants, scientific and official members, for discussion and approval.

Maturity Trials.—In 1921 Potato Maturity Trials were started at Ormskirk with the object of establishing the time of ripening of different varieties, and also of gaining information as to the correct method of attacking the problem of yield testing, which, with potatoes, presents such exceptional difficulties. No conclusion can yet be published, but the work is progressing satisfactorily.

All the Institute's potato work, including that of testing and multiplication of new varieties, is controlled by the Potato Committee. The Council of the Institute have recently approved a scheme recommended by this Committee by which novelties may be taken over from breeders at an early stage, tested for yield and quality (on land in Scotland lent to the Institute for that purpose) and multiplied for distribution through the trade; the proceeds to be shared by the breeder and the Institute. Already offers of new varieties to the limit of the Institute's capacity have been received, and the work will be started during the coming season.

The whole of the executive work connected with potatoes is under the immediate control of Mr. H. Bryan, who has lately been transferred from the Ministry of Agriculture for this purpose.

Fellowship.—As has been explained on p. 1075 under "Finance," such was the success of the initial appeal for funds, that it has been possible, with the assistance of the Development Fund, to erect the Headquarters and organise the work for which the Institute was founded. It is now essential that funds shall be forthcoming to secure to it an assured annual income sufficient to enable it to maintain its present activities and to embark on further projects designed with a view to the improvement of crops. With this as its aim, the Council has initiated a Fellowship of the Institute, which, it is hoped, will meet with wide support from all those who have at heart the success of British farming.

The Fellows have a right to elect as members of the Council one of their number for each five hundred (or part of five hundred) Fellows up to a maximum of four. Fellows will be kept in touch with the work of the Institute by means of meetings at which papers will be read, and by the Institute's publications. The Council, however, do not base their appeal on the anticipation of personal advantage as an incentive to Fellowship, but rely on an altruistic appreciation of the strength which will be given to the Institute by the subscriptions, and, still more, by the continuing interest of a large and representative body such as is hoped will come forward to be enrolled.

The fees payable by Fellows are as follows:—

£1 1s. Annual.

£7 7s. Composition for 10 years.

£15 15s. Composition for Life.

From a financial point of view it must be pointed out that every guinea forthcoming from private sources has a potential value of three guineas towards the income of the Institute.

Although the Fellowship has only recently been started, the support so far forthcoming encourages the belief that when the scope of the work which the Institute is undertaking is appreciated, the hope of the Council that two thousand Fellows will be enrolled will speedily materialise. Among those already elected are His Royal Highness The Duke of York, K.G., President of the Royal Agricultural Society, The Duke of Bedford, The Marquess of Crewe, The Earl of Ancaster, The Earl of Derby, The Earl of Crawford and Balcarres, Viscount Milner, Lord Ailwyn, Lord Clinton, Lord Bledisloe, Lord Ernle, Sir Gilbert Greenall, Sir Harry Verney, Sir Matthew Wallace, The Hon. E. G. Strutt, The Rt. Hon. E. G. Pretyman, M.P., The Rt. Hon. Walter Runciman, Lieut.-Col. The Rt. Hon. Sir Arthur G. Boscawen, Sir Thomas Middleton, Mr. Charles Adeane, Mr. Samuel Farmer, Mr. R. R. Robbins, and Lady Margaret Boscawen.

The Prime Minister, the Institute's first Life Fellow, has written to the Chairman as follows:—

10, Downing Street,
Whitehall, S.W.1,
3rd November, 1921.

Dear Sir Lawrence,

I have been following with great interest the rapid progress of the National Institute of Agricultural Botany, and congratulate you and your colleagues on the serious and useful work the Institute is already doing for the farming community. You are wise to broaden the basis of your organisation by creating a Fellowship of the Institute, which will enable everyone concerned with the improvement of crops to help forward the good work.

I gladly show my appreciation of what you are doing by asking to be enrolled as one of the first Life Fellows of the Institute.

With all good wishes for its continued progress both in successful work and in wide support from everyone interested in agriculture,

Believe me,
Yours sincerely,
(Sgd.) D. LLOYD GEORGE.

It is obvious that this letter has been, and will be, considered worthy of the most serious attention of that growing number of persons who realise that the future prosperity of agriculture in the British Isles is widely dependent on what the Royal Agricultural Society of England retains as its motto—"Practice with Science," and more narrowly on the Institute's motto of "Better Seeds; Better Crops." A copy of the second report of the Council and particulars of the Fellowship can be obtained on application to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

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PLOUGHING AND PLOUGHING MATCHES.

H. G. RICHARDSON, M.A., B.Sc., and G. E. FUSSELL.

Ministry of Agriculture.

THE opinion is current that ploughing matches are one of those time-honoured institutions of the countryside which are smitten with decay. The farmer and the landowner, it is thought, do not encourage the men, and the men who take a pride in their work are a dying race and are not eager to compete in such matches. From figures which will be quoted later it can be definitely shown that, certainly in many parts of the country, this is far from the truth, although in some districts ploughing matches may have died with little immediate prospect of resuscitation. It is hardly necessary to refer to the obvious fact that changes in the system of agriculture cannot fail to affect all competitions of technical skill; ploughing matches may give way to cheese-making and milking competitions, or they may conceivably one day disappear because they no longer have any vital bearing on the daily task, because personal skill and personal pride are

centred around other things than driving a furrow straight and setting it up and showing off a fine team. Nevertheless, so long as the spirit lives which underlies all matching of skill with skill or pride with pride, there will be a transformation only, the spirit will clothe itself in a new guise. Not a little may be learnt from the story of the rise and progress of ploughing matches, and of the days before ploughing matches were inaugurated.

One of the most poignant passages in the whole of the literature of agriculture may be found in a little Latin reading book which was written for English boys of the eleventh century. Each of the boys in the class is made to assume a different character and describe his day's work. This is the ploughman's story :—

"I work hard: I go out at daybreak, driving the oxen to the field, and I yoke them to the plough. Be it never so stark winter I dare not linger at home for awe of my lord; but having yoked my oxen, and fastened share and coulter, every day I must plough a full acre or more. I have a boy driving the oxen with a goad iron, who is hoarse with cold and shouting . . . . Mighty hard work it is, for I am not free."*

Long after the eleventh century the typical Englishman was the unfree ploughman wearily ploughing the acre strips in the open field. Quite humane and enlightened people could contemplate with equanimity a state of society in which "the poor bondman's son is disposed by his birth to be a bondman all his life, as his fathers have been before him a hundred years."† As Wyclif said : "rulers think it as just and as natural for the whole class of bondmen to serve them and their class in worldly affairs, as it is natural for wood to burn."‡

It is not an accident that improvements in agriculture during the Middle Ages were so slow as hardly to be perceived, and that the recognition of serfdom as a disgraceful anachronism and its consequent disappearance§ should have been followed by that burst of agricultural invention and teaching which marks the seventeenth century.‖ The gradual relaxation of the bonds which had enslaved the unfree labourer not only freed his spirit but it brought about a gradual and subtle change in the attitude of

* Aelfric's Colloquies in *Analecta Anglo-Saxonica*, pp. 19–20; York Powell's translation.

† *Dives and Pauper* (early fifteenth century): Berthelet's edition (1536) p. 33b.

‡ *De Civili Dominio*, i, 247.

§ Cunningham, *Growth of English Industry*, 533–4.

‖ Lord Ernle, *English Farming*, Ch. V:
McDonald, *Agricultural Writers*, p. 67.

the landowners and those who served them. No one who has read Mr. Hammond's recent article in this *Journal**—no one who has an acquaintance with the novels of Fielding, to mention no other writers—will be under any illusion as to the amount of freedom which the farm labourer enjoyed in the eighteenth century; no one who has read the *Husbandry* of Walter of Henley† will be under any illusion as to the attitude of the mediæval labourer to his task. Imperfect as the eighteenth century may have been it held out an immeasurably greater promise than the thirteenth; the teaching of the seventeenth century, which at the time must have seemed often ineffective and futile, was not lost.

In the eighteenth century the passion for agricultural improvement grew and spread until nearly every landowner and many farmers at least affected to be imbued with it. The progress of inclosure at once stimulated and was stimulated by the movement. To an increasing extent men set themselves to devise new and improved implements. So far as the plough was concerned many of the modifications had long been anticipated, for already at the beginning of the sixteenth century, and probably centuries before, there had been great diversity of types to meet the different conditions of different districts.‡ Lord John Somerville, writing in the early years of the nineteenth century, stated on the evidence of drawings published in the middle of the seventeenth century by Walter Blith,§ that little originality of invention or improvement had been manifested in the greater part of the swing and wheel ploughs constructed since that date. He will only admit that two or three improvements "have really borne the test of practice with credit and success."‖ However this may be, there was a great interchange of ideas and conscious effort towards improvement: doubtless there were "numberless fancied improvements," but it cannot be doubted that the general level of plough design was greatly improved. The Rotherham plough, which was highly esteemed in the latter part of the eighteenth century, was itself of Dutch origin: but there were abundance of types in England itself which might

* Oct., 1921, p. 586.

† *Ed.* Lamond and Cunningham, esp. pp. 10, 11.

‡ See the commencement of Fitzherbert's *Book of Husbandry*; the relevant passages may be found in McDonald's *Agricultural Writers*, p. 14.

§ Reproduced by McDonald, *op. cit.* p. 102.

‖ *Facts and Observations on Sheep, Wool, Ploughs, and Oxen*, pp. 129, 130.

suggest improvements to visitors from a distance.* In 1767, the Society of Arts, which had been founded thirteen years previously, distributed three premiums of £50 for plough inventions,† including the skim-coulter plough of Mr. Duckett of Esher, which earned the approbation of Lord John Somerville himself.

The object of improvement was quite clearly recognised to be better cultivation and reduced expense, and the means to these ends were seen to be better implements and greater skill in using them. The problem could not be better stated than by Arthur Young, in 1797; his immediate subject is a ploughing match at Petworth, but his statement of the case was intended to have general application and is as true to-day as one-and-a-quarter centuries ago‡ :—

"There are four distinct species of merit which demand to be appreciated:—

1. The skill of the ploughman.
2. The goodness of the plough.
3. The furrow ploughed.
4. The power of the team.

"The first of these objects is seen in the knowledge with which the ploughman adapts the work to the crop in question, to lay the furrows in such a manner as shall encourage all grass and weeds to vegetate, if (as in fallowing) that is requisite; or, on the contrary, to exclude them from the air as much as possible, as in turning a clover ley for wheat; as well as to vary his depth and breadth of furrow to the object of the farmer. His skill is also seen in the straightness and evenness of his work; in setting his plough to the nature of the soil, and even to the season, whether moist or dry. All these, and several other points, give an opportunity to a ploughman to shew his skill even with a bad plough; and with the best, a bad ploughman will contrive to make wretched work. . . .

"The goodness of the plough is a most essential point; for there are such as no ploughman can make good work with; and some so heavy . . . . . that there must be four horses to draw it . . . . The Kentish turnwrest will . . . . lay the furrows well; but having a chisel point, of only two, three, or four inches wide, and a heel nine or ten, must in various operations drive over roots and weeds without cutting them. The little Suffolk swing plough is a handy tool for three or four inches of depth, but very deficient for a right

* cf. Arthur Young's statement of his own method of proceeding: *Annals of Agriculture*, Vol. I, p. 118, "Mr. Arbuthnot's plough was, beyond all doubt, the best that was tried and plainly owed its superiority to the share rising as an inclined plane and melting gradually into the admirable sweep of its long mould-board. I was present the whole day, and was so convinced of this, that I determined to apply those parts of it to the others of Mr. Brand's construction. I executed the idea in Hertfordshire, without all the success I expected, but I have since brought it to bear, and formed from both, a plough nearer to perfection than any I have yet seen . . . ."

† Dossie, *Memoirs of Agriculture*, 1, 12.

‡ *Annals of Agriculture*, XXIX, p. 514.

staple depth . . . . Instances might be multiplied; but the fact is obvious, that furrows may be well turned to the eye, but yet bad work made.

"Another circumstance of equal importance . . . . is, to consider how well the construction of a plough is adapted to the peculiar soil or crop, which is the object of the experiment . . . . By consequence . . . . the merits of a plough will not be appreciated, if such variations be not in contemplation; and that plough considered as the best which is adapted to the most uses . . . .

"The team does not seem to carry much difficulty in the way of a fair decision; the expense of keeping horses and oxen, or asses. or mules, should be carefully calculated, the interest of their first cost estimated, their duration and liability to disease included, and the expense thus deduced of performing a given portion of work, as merit here is all included in cheapness. But in ascertaining what this portion really is in any trial; that is, the quantum of power exerted; there are great difficulties, if the furrow turned by every plough be not very nearly of the same dimensions: a circumstance that clearly appeared in the trials of ploughs by the Society of Arts, in which the draught was ascertained by means of a coiled spring, with an index of the hundred weights applied in drawing. Probably this difficulty will render it advisable, in such trials, that the furrow to be opened be previously specified; allowing a breadth sufficiently proportioned to the depth required."

A full account of the trials carried out by the Society of Arts had appeared in the first volume of the *Annals of Agriculture*,* under the title, "Experiments to ascertain the force necessary to draw various ploughs." The instrument used was a spring dynamometer such as is still employed for measurements of no great refinement. It was invented by Mr. Samuel More, the Secretary to the Society, with a view to determining the merits of an iron plough which had been submitted by Mr. John Brand for a bounty. Six ploughs in all were tried:—the Rotherham plough; two ploughs of Mr. Arbuthnot's, described merely as "red" and "blue"; Mr. Ducket's trenching plough; the common Surrey plough; and the new iron plough. Twenty tests were carried out, with furrows of different depths, and with weights added to certain of the ploughs to bring them up to the weight of others; the draught was registered in fractions of cwt. Mr. Brand was given a bounty, but Mr. Arbuthnot's plough was "beyond all doubt the best."

The conclusions drawn by the Committee, as Arthur Young said, "deserve no slight attention":—

"It appears that the weight of the plough is of little consequence, very contrary to common ideas; that heaviness is even an advantage oftener than the contrary; and that in some instances to a surprising degree. The weight of the plough is the least part of the horses' labour: the great object is the resistance met with in the cohesion of the earth; lightness does nothing to

* p. 113.

overcome this; it is effected by just proportions only. If a plough is not made on true principles, the lightness is prejudicial by adding to the unsteadiness of all ill-made ploughs.

"It also appears very decidedly, that the share should be nearly, if not quite as broad in the fin, as the plough is wide in the heel, in order that all the furrow may be cut, and not torn up by force."

Ploughing matches appear to have sprung up at about the same date that the dynamometer was invented. The present writers have found no certain reference to ploughing matches earlier than 1784, when the Odiham Agricultural Society held a competition on the Tuesday of Whitsun week, and a prize of three guineas was awarded to the "ploughman that ploughed the best within a given time to be determined by the stewards." Other prizes were given to the boy driving the horses and to the two next best ploughmen and to the boys employed with them.* Similar matches then became not infrequent, but it is clear from Arthur Young's anticipation in 1797 of "the vast effect of such annual meetings, were they to take place in various other districts of the kingdom, as well as Sussex"† that he was then acquainted with but few.

It was not to be expected that all societies would have Arthur Young's wide vision or insist upon the number of factors for which allowance should be made in comparing ploughs and ploughing. Good work, as judged by conventional standards, was a thing easily to be understood, as was also the reduction in the strength of the team (a rough and ready indication of draught) and the possibility of dispensing with the driver. All these points were clearly of importance, while none but powerful and wealthy societies could be expected to concern themselves with scientific refinements.

The evidence of contemporary witnesses is overwhelming that ploughing matches had an immense effect in raising the skill of the ploughmen and reducing the working expenses.

"These ploughing matches," said Francis Erskine, "raise such emulation amongst the youth, that a gentleman has assured me, that, when travelling along the road, he has seen a young lad, (who was ploughing without any person in the field with him), as soon as he came to the end of the furrow, stop, and look back on his work; and on his perceiving part not done to his mind, that he immediately turned, took his plough to the spot, and endeavoured to rectify the error with great earnestness."‡

* *Annals of Agriculture*, III, 50.

† *Annals of Agriculture*, XXIX, 520. Prizes were at this period given on other tests of excellence, as, for example, a prize of "five guineas and a silver cup by the Bath Society in 1784 for ploughing 442 acres of land with a pair of horses without a driver": *ibid.*, III, 50.

‡ *Annals of Agriculture*, XXIX, 332.

"The ploughmen of Clackmannanshire," it was said, "from being notorious for their want of skill in tillage, are now reckoned among the very best in Scotland." This was a direct result of ploughing matches. "The fields of the good farmers, indeed, appear cultivated like gardens." There was, however, a serpent even in this Eden: in some counties the farmers alleged that the matches tended "to make the successful ploughmen saucy and self-conceited, and ready to seek higher wages."* It is hard to accept the workings of the spirit of freedom for good or ill.

In some cases the rules were directed to reducing the number of draught animals and men employed: in the matches instituted by Lord Egremont at Petworth the prizes were awarded for an acre ploughed "in the best manner, with the least assistance, and with the fewest oxen." † Even when the rules were not so definite and the quality of the ploughing merely determined the prizes, the contrast with competing teams could not fail in its effect. At the first match at Alloa, for example:—

"One of the members of the club had a good servant, who was, however, prepossessed in favour of three horses in the plough, with a driver. The master sent him to make the trial, in hopes of convincing him, and his other servants, of their inferiority; and it succeeded; the whole of them being so ashamed of this man's work, as to make them ever since reject and give up asking for a third horse, or a driver."‡

There was, however, a reverse side to the picture. There was a danger lest too wide a generalisation should be based upon the performances under match conditions. Arthur Young suggested to the Bath and West Society that experiments conducted over a period were of more value than competitions in the general use of drills, ploughs or horse hoes,§ while Lord John Somerville stated some years later that he was

"not disposed to draw absolute conclusions from ploughing matches, because much may depend upon accident; besides that exertions might be made for three hours, without much apparent distress, which, nevertheless, could not be maintained for three weeks, and so the public becomes misled."‖

Besides open ploughing matches trials were arranged for the purpose of determining the superiority of particular types or to decide a wager. One of the most interesting of these semi-private trials was that held on the Norfolk Farm in Windsor

* *Annals of Agriculture*, XIX, 332.
† *Ibid*, p. 511.
‡ *Ibid*, p. 331.
§ *Letters and Communications addressed to the Bath Agricultural Society.* (Ed. 1788.) II. p. 185.
‖ *Facts and Observations on Sheep, Wool, Ploughs and Oxen*, p. 141.

Great Park in 1798 in order to test the qualities of Lord John Somerville's improvement of the West of England double furrow plough against two Norfolk ploughs and one Rotherham plough as ordinarily used on the King's Farm.* The result of this trial was a quite definite indication that the improvements designed by the President of the Board of Agriculture enabled more work to be done under given conditions in a day than could be effected by the use of the single ploughs. About a week later Lord John Somerville's plough was entered in the Petworth ploughing match but did not obtain a prize owing apparently to the fact that it had been damaged during the journey from Windsor.†

Another interesting competition, the basis of which was a wager regarding the relative merits of the single and double furrow ploughs, took place in Essex in June, 1802. The local farmers had been very much opposed to the latter type of plough, but its backer won the wager and the farmers were converted.‡

Scientific or quasi-scientific tests tended to be overshadowed by contests which matched man against man and team against team. The inquiring spirit, the infinite patience that will make the infinite number of measurements which is science: these were not long prominent and emerged only at long intervals. About the year 1800 the names of many more societies engaged in promoting ploughing matches appear in the periodicals.§ but records of careful tests and trials are infrequent.‖ In 1842, however, the Royal Agricultural Society of England allotted 300 guineas to be awarded as prizes for implements exhibited at their annual show, and in the following year "a great number of ploughs were put to work on Mr. White's farm at Rough Heanor and inspected by the judges."¶ It became the practice of the Society to reserve the right to try in the field any implement exhibited,** and the Bath and West of England Society later adopted a rule which permitted exhibitors to show their implements actually at work.†† There

* *Annals of Agriculture*, XXXII, 154. *Journal R.A.S.E.* 3rd *Series* VIII, p. 9.

† *Annals of Agriculture*, XXXII., 154.

‡ *Facts and Observations on Sheep, Wool, Ploughs and Oxen*, p. 143.

§ For an account of measurements of draught with a dynamometer in 1839, *see Jour. R.A.S.E.* I, 140, 219.

‖ E.g. Cardigan: *Annals of Agriculture*, XXIX, 278: Sussex, *ibid.*, p. 587, Manchester, XXXIII, 635: Lancaster, *ibid*, 629.

¶ *R.A.S.E. Journal*, IV. 467.

** *Ibid.*, 453.

†† *Journal of Bath and West of England Soc.* (1871) III. p. 197.

appears, however, to have been no sustained attempt to follow on the experimental work inaugurated by the Society of Arts in 1784. Doubtless various forms of tests were carried out by manufacturers as they adopted new designs, but public trials became practically limited to ploughing matches. Of the number held at different times or at any one time in the nineteenth century no estimate appears to have been made or to have survived. Doubtless much might be elicited, if it were worth while, by local inquiry: but we may accept the received opinion that there has been a marked decline within the recollection of the older generation. Recently inquiry was made by the Ministry of Agriculture of County Organisers and others, and from the replies which have been received it would appear that some 250 annual competitions are still maintained in England and Wales. In a few instances tractors are now included, but in the great majority of the matches horse-ploughs alone are entered. In some counties no matches appear to be held even where there is a great deal of arable farming: but it is likely that complete information has not in all cases been in the possession of the Ministry's correspondents.

In England, the county with the greatest number of matches is Yorkshire, where 29 are reported to be held annually: curiously enough no matches are reported from the East Riding. The other counties for which figures are given are as follows:—

21 Suffolk.	4 Berkshire, Buckingham, Hampshire, Surrey.
15 Kent.	
13 Durham, Essex.	3 Worcester.
10 Lancashire.	2 Northampton.
9 Hereford, Nottingham.	1 Cambridge, Cheshire, Cornwall, Gloucester, Hertford, Middlesex, Northumberland, Rutland, Shropshire, Westmorland, Wiltshire.
8 Oxford.	
7 Somerset.	
5 Devon, Lincoln, Sussex.	

In Wales and Monmouth the number of matches appears to be large as contrasted with England. In Pembroke there are 33, in Brecon and Radnor together 24, in Cardigan 20, in Montgomery there are 7, 3 each in Flint and Monmouth, and 1 each in Carmarthen and Glamorgan.

To some extent the national and local tractor trials have taken the place of ploughing matches: and many farmers appraise the work done very much as they would the work at a ploughing match. This is not wholly to the bad, for careful work is as important with a tractor as with a team of horses, provided the standard has a real meaning, a point upon which,

as we have seen, Arthur Young thought it wise to insist many years ago. Whereas, however, most farmers are, or believe themselves to be, good judges of horses, they are rarely good judges of tractors: and the points of a tractor cannot be summed up in the same way. If the tractor is to be the power-unit of the future it will be necessary to take a leaf from the book of the users of commercial motor vehicles, and award prizes for well-kept engines as well as good ploughing. Such competitions, provided the drivers are contented and take a pride in their work (which will only be the case if they are contented), may work a charm not very different from that which the early ploughing matches are reported to have done in improving the work of ploughmen: for the bane of the tractor is the repair bill, and the way of escape is a fuller understanding of the machine, a higher craftsmanship. As for judging between tractor and tractor, that is a matter for prolonged test and scientific study, and if the farmer is to form an independent opinion he must be guided largely by independent reports.

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DISEASES OF THE SWEDE CROP IN CUMBERLAND AND WESTMORLAND IN 1921.

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Ministry of Agriculture.

Powdery-Mildew of Swedes.—One of the most prevalent diseases of swedes throughout the country last year was powdery-mildew* and in the northern counties the attack was unusually severe. In the early part of the summer, 1921, the swede crop in practically all parts of Cumberland and Westmorland looked exceptionally healthy and vigorous, and promised, in spite of the drought, to be an excellent crop. About the middle of August, however, mildew developed and after that date the disease steadily became worse and the crop received a severe check. Not only were the older leaves affected, but the young leaves became mildewed before they attained any great size. Rain fell copiously in August, so that the damage to the crop may be regarded as due to mildew and not to drought.

* Another mildew frequently attacks swedes, namely the False Mildew, caused by the fungus *Peronospora parasitica*. This disease is more prevalent in wet seasons and may cause much destruction of the foliage

Swede crops over the whole of the two counties have been examined and the disease found to be equally severe in all parts, practically no difference in intensity being observed with varying elevations, types of soil and aspects.

The disease has undoubtedly caused the farmers considerable financial loss, which may probably be estimated at about £2 per acre. This estimate is calculated as follows:—(*1*) The average yield for the counties is regarded as 20 tons per acre, but the very promising crop has only yielded 18 tons per acre. Valuing the swedes at 10s. per ton, the reduction of 2 tons amounts to a loss of £1 per acre. (*2*) It is the general opinion of farmers that the keeping qualities of swedes attacked by mildew are adversely affected. Maturation is interfered with and owing to the liability of late secondary growths the roots are apt to be soft and unripened. It is possible also that owing to the partial destruction of the foliage by mildew the roots are more liable to crack, and, consequently, an undue proportion would rot in storage. (*3*) It is believed that the nutritive value of swedes attacked by mildew is reduced. If this were so sheep folded on the crop would derive less benefit from the bulbs and the leaves than from a healthy crop. Precise scientific evidence for the headings (*2*) and (*3*) is still scanty, but it is reasonable to assume that at least another £1 per acre may be allowed for the two headings.

With regard to control measures, it is probable that in common with many other mildews the attacks of swede mildew could be reduced by applications of potash fertilisers. At any rate care should be taken that potash is not deficient.

Club Root, or Finger-and-Toe, in Swedes.—This disease, whilst not nearly so severe in Cumberland and Westmorland as it was in 1920 was, nevertheless, generally present. Almost all crops had traces, in some the disease was very noticeable and in a few it was serious. Very few crops (probably not more than half a dozen) have been observed where no disease was found.

Most of the arable land in this district is a light sandy loam, usually deficient in lime, and is therefore highly suitable for the development of finger-and-toe. Swedes, moreover, come round in the rotation usually every fifth or sixth year, and it is well known that five years is not a sufficiently long period to starve out the disease. Taking these two factors into consideration, it is not surprising that finger-and-toe is the cause of huge losses annually in this district.

The swede crop usually follows oats in the rotation, but sometimes potatoes are the preceding crop. It was remarkable last year that where swedes were grown after oats there was more finger-and-toe in the crop than in those crops which followed potatoes. Indeed, the only crops of swedes last year where no finger-and-toe was found, were grown on land which carried potatoes the previous year.

It is also noticeable that there is always more finger-and-toe to be found along the headlands, in the vicinity of gates, and in damp portions of the fields, than in other parts of the field. Portions of diseased roots and contaminated soil are liable to be carried to gates and headlands on boots and wheels, and these would infect the soil very heavily, but in addition such places are of necessity trampled and puddled, and, consequently, the soil is not so thoroughly aerated as in other parts of the field. It is possible, therefore, that thorough cultivation and aeration of the soil would tend to prevent the disease. Possibly this may account for the fact that swedes following potatoes are freer from finger-and-toe than swedes following oats, since with a crop of potatoes the soil receives more cultivation.

It would seem that early sowing combined with a good seed bed also tends to check the disease. In 1921 most crops in this district were sown early, with the soil in really good condition, and it would appear that the few crops in which the disease was severe were sown late. The most seriously diseased crop observed was sown about the first week in August and 90 per cent. of the plants were affected, the roots being small and stunted. This crop was a complete loss.

Owing to the slightness of the attacks last season the actual money losses sustained by the farmers were almost negligible; this is due probably to the dry summer and early sowing in a good seed-bed. In an average season the losses are much heavier. The damage caused by finger-and-toe in this district in an average season is much greater than the damage caused by wart disease of potatoes. The protective measures for finger-and-toe, and the amount of lime or chalk required, are fully dealt with in Leaflet No. 77.

Dry Rot.—In addition to mildew and finger-and-toe, swedes are sometimes affected by the disease known as dry rot. This disease was first described in 1900 by Professor M. C. Potter.* The disease is caused by a minute fungus, *Phoma napo-brassicae*, which attacks the roots and forms a soft, brown rot, but one

* This *Journal*, Vol. VI, pp. 448–456.

which is dry. It is not very common in England, but occurs in some of the wetter counties and may be locally prevalent in parts of Cumberland and Westmorland and in certain seasons may be responsible for very heavy losses. Dry rot is known to be very much favoured by heavy dressings of nitrogenous manure. Where the disease is prevalent, therefore, farmyard manure should be applied sparingly and care taken that the land is not deficient in lime or potash.

Bacterial Disease.—Another disease with which swedes are affected is wet rot caused by the bacterial parasite *Bacillus carotovorus*. The bacterium gains entrance to the roots by means of minute wounds; high manuring favours the disease and at times a large proportion of the crop may be lost. Last season the rain following the long drought caused extensive cracking of the roots and apparently the wet rot which was found in some fields was due to the parasite gaining entrance to the roots by means of these cracks. Where either wet rot or dry rot is present in the crop special care is necessary as to storage.

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CULTIVATION OF THE HOP CROP.

III.—SYSTEMS AND METHODS OF TRAINING.

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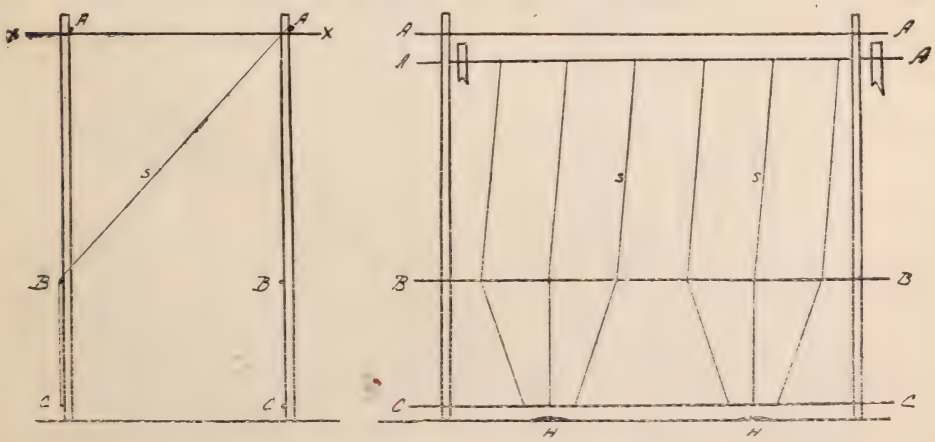
THE hop is a climbing plant. If allowed to grow freely the tip of the stem executes a spiral in a clock-wise sense so that the stem tends to embrace any stick placed in its line of growth and encircles it as it grows. Again, the normal habit of growth is vertical so that a hop stem encircles a vertical support much more readily than one which is sloping. Finally, the hop stems and leaves are thickly covered with reflexed hooks, causing the rough feeling of the hop-bine, so that when once the stem has encircled its support the hooks cling to the support and tend to hold the stem in position upon it. In all systems of hop training advantage is taken of these chracteristics of the growing hop stem for supporting the bines.

Polework.—In earlier times 10 ft. to 16 ft. poles alone were used as a means of support. Three or four of these comparatively thin poles were set in the ground around each "hop-hill" with the tips of the poles slanting outwards, and the hops were tied to the poles by means of rushes or bast—hence the origin of the word "tying." Very few hops are grown on poles alone

at the present time, though a few grounds may be found in which two poles are placed to each " hill " and string led from a height of 3 ft. 6 in. on the poles of one row to the tops of the poles in the next.

Systems of Wire-work.—Generally, at the present time hops are grown upon one of several systems of wire-work. The wire consists of galvanised stranded wire composed of 3 to 5 or 7 strands according to the strain which it will be required to support. The wire framework is carried upon stout poles cut generally from larch, spanish chestnut, ash or occasionally spruce and other woods. Before use, the poles should be roughly shaved of their bark, seasoned and dipped in hot creosote, 2 ft. 6 in. to 3 ft. high, so that the part most likely to decay—just above and below the surface of the ground—may be adequately protected. With the softer woods, such as spruce, the poles should be dipped from end to end or their " life " will be short. The poles are sharpened and set from 18 in. to 2 ft. in the ground, and vary in height from 11 ft. to 16 ft. above ground and in a few cases are even higher.

This wire-work supports the string, upon which the hop-bines climb. In England the string is universally made of coconut fibre, which is rough; in America cotton string is more frequently used because it is cheaper there, but cotton is smoother and the hops do not cling so well in windy weather. The string should have a breaking strain of 50 to 60 lb., and should be uniform and run out at least 100 yards per pound.



Butcher System of Training Hops.

AA, top wires; BB, middle wires; CC, bottom wires; XX, cross strain wires
H, hop hills; S, strings.

FIG. 1.—End view. FIG. 2.—Side view.

The Butcher System (Figs. 1 and 2).—This system was introduced by the late Mr. Tom Butcher, of Selling, and was the first system of wire-work to be adopted in England. Originally the system was applied to a hop garden, the hills of which were planted rectangularly 6 ft. 6 in. apart in each direction, making about 1,000 hills per acre. The poles were placed in such a way that 2 hills were situated between them in every row of hops so that 500 poles were required per acre. The poles were 12 ft. out of the ground and three horizontal wires were attached to each row of poles; the bottom wire was 6 in. above the ground; the middle wire was between 3 ft. 6 in. and 4 ft. high, and the top wire was fixed about 6 in. below the top of the poles. The wires in each case should be fixed with staples which should be driven in obliquely to the grain of the pole.

Three strings were tied to each hill in such a way that they spread out like a fan from a point on the bottom wire just above the " hill " to be equally spaced upon the middle wire immediately above, and then sloped parallel and equidistant from each other to the top wire on the next row of poles. Since the slope of each row of strings is in the same direction, the pull on the wire-work, especially when the growth of hops is heavy, is very great and all in the same direction; in order to withstand this, specially stout cross-wires have to be fixed to each row of poles at right angles to the alleys and anchored substantially at the outside of the garden. The slope of the string should preferably be away from the prevailing wind; since this is generally from the south-west the strings should slope towards north-east; with this slope the bines are not so badly blown from the string in windy weather, nor are the hop cones so badly bruised by a wind when reaching maturity.

Butcher's original specifications have naturally been modified in many ways by different growers; thus the hops in the rows are frequently 7 ft. and even 7 ft. 6 in. apart so as to allow a wider space between each string and prevent so much matting together. The alleys also are frequently 7 ft. to 8 ft. wide to allow more room for the passage of horses with tillage implements, hop-washers, etc., but the wider rows mean that the slope of the strings becomes flatter and the hops may fail to encircle the string with each spiral in their growth so that training becomes very expensive; in order to obviate this the height of the poles and the top wire is frequently raised to 14 ft. or even 16 ft.

The advantages of the Butcher system are considerable and it is still largely adopted. In particular the hops are well

exposed to sunlight and air so that they are enabled to develop healthily into fine large hops; the bines are all suspended in one plane and are therefore capable of easy spraying with the hop-washer, except when the bines get round the top of the poles, by which they are protected from the spray; as compared with the old pole system (and this is true of all wire-work systems) the hops can be easily pulled down so that picking is simplified. On the other hand, from the very fact that all the bines are suspended in one plane close together, they tend to become interlocked with each other and this leads to much shattering when they are pulled down for picking. Again, when planted in wide rows, especially if frequent winds blow

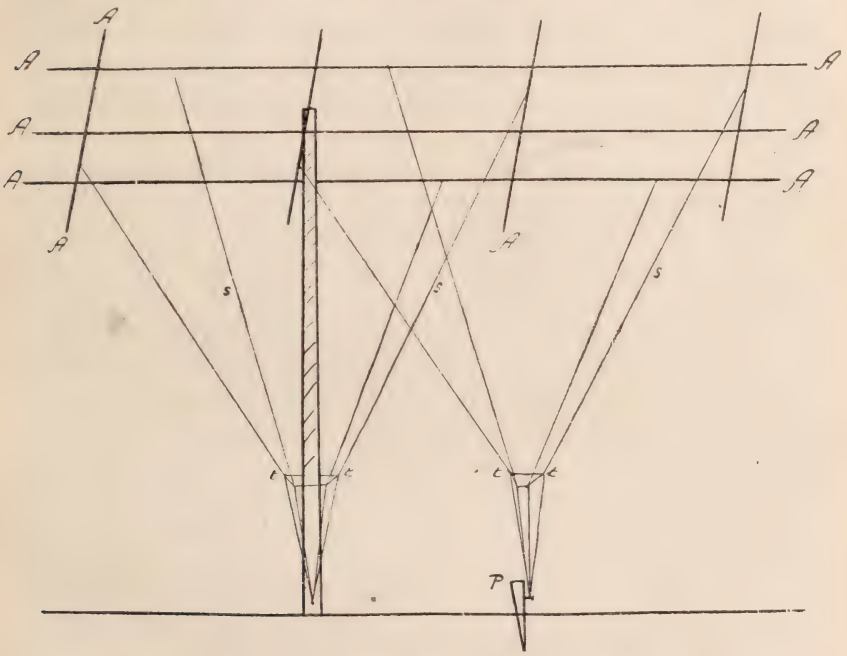


FIG. 3.—Umbrella System of Training Hops.
AA, top wires; S, strings; TT, coupling strings; P, stump.

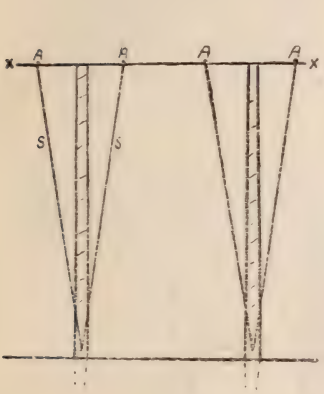
against the slope of the string, the bines fail to encircle the string and much hand training is required to keep the bines growing on the string. Another minor disadvantage is the fact that the bottom and middle wires prevent the passage of horses and implements for cross tillage, but as counterbalancing this is the fact that when a middle wire is present and cross tillage not practised, bines can be led from a strong "hill" to furnish the strings on adjoining weak or dead "hills."

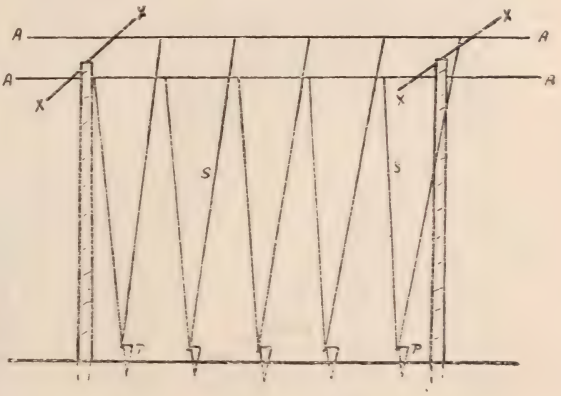
The Umbrella System (Fig. 3), which takes its name from a somewhat fanciful resemblance to the spokes of an umbrella, is commonly used in the Weald and Mid-Kent. The spacing of the hills is similar to that in the Butcher system, but the poles, instead of being situated at intermediate distances between the hills are placed closely in contact with the hills: they are arranged symmetrically and generally 1 pole is provided for every six "hills." No bottom and no middle wires are fixed, but the top wires cross each other above the centre of each hill. Four strings are used for each hill and are attached below to a peg or hook fixed in the ground; the four strings are coupled together at about 3 ft. 6 in. above the ground by a string which is hitched to all of them so that each of the 4 main-strings forms a corner of a 9 in. square. From this point the 4 strings radiate at right angles to each other and are tied to cross-wires which form a square above the hills nearest to the central hill, as shown in the diagram.

The advantages of this system are that four strings are obtained for each hill instead of three, they are exposed to the air more advantageously, and cultivation and washing can be executed in both directions. Moreover, since the pull of one string balances the pull of the string opposite to it, the strain upon the wire-work is more or less balanced and the wear and tear is less; consequently fewer poles are required—generally about 160 good poles per acre. On the other hand, spraying by horse-drawn hop-washers is rendered more difficult by reason of the crossing of the strings so that one bine protects another from the spray, and in districts where aphis is abundant this is a serious drawback; the slope to the strings is considerable and consequently training is increased; lastly exposure to light is not so good as in the Butcher and consequently the bines do not hop down so well—the lower bine carries no hops, and the hops do not grow out quite so well.

The Worcester System (Figs. 4 and 5) was first practised in the hop districts of Worcester and Hereford. In the typical case the "hills" are planted in rows 7 ft. or 8 ft. apart, but the "hills" in the row vary from 3 ft. 3 in. to 3 ft. 6 in. apart only. Poles are placed from 15 ft. to 20 ft. apart in the rows, and the wires which carry the string are not directly attached to the poles, but are carried upon stout cross-wires; two top string wires are suspended upon these cross-wires over each alley, equidistant apart from each other and from similar wires in adjacent alleys. Two strings only are supplied to each hill:

these are fastened to pegs or hooks in the ground, and led in opposite directions to the nearest string wires above, usually without any coupling at breast level. The slope given to the string is much less than either in the Butcher or in the Umbrella, but on the other hand the top wires are generally higher and in some cases even 18 ft. high.





Worcester System of Training Hops.

XX, cross straining wires; AA, string wires; SS, strings; PP, pegs.

FIG. 4.—End view. FIG. 5.—Side view.

The advantages of the Worcester System are considerable; the heads are carried over the centre of the alley and are consequently more easily washed than with any other system; the heads are well exposed to light and air, and because the slope is more nearly vertical less training is required. As in the case of the Umbrella System, the pull of each string is counterbalanced so that the strain on the wire-work is not great. The disadvantages are that cross cultivation is impossible and that a greater number of "sets" are required in planting in the typical case, but this cost may be overcome if 4 strings are supplied to each hill and these distributed along a middle wire.

The Cross Butcher System (Figs. 6 and 7) is the most recent development of stringing systems; it is a modification of the Butcher System so as to obtain the advantages of the Umbrella System. The hills are planted as for ordinary Butcher work, but the poles are set like the Umbrella close against the hill. On the other hand the cross-wires are not carried over every hill but over every second hill, and, consequently, the poles are set in rows in two directions as in the Butcher work. No bottom or middle wires are necessary. Four strings are used for each hill; they are tied to pegs below, coupled in pairs at

3 ft. 6 in. high and then two are sloped forwards and two backwards to the string wires along the alleys in front and behind. The advantages and disadvantages of this system are little different from those of the Umbrella System.

Stringing Practice.—As previously stated the type of string used for hops in England is coconut, to which on account of its rough character the hop bines readily cling. The operation of stringing the hops is winter work and is generally carried out after Christmas, and should be completed before other work becomes pressing in spring.

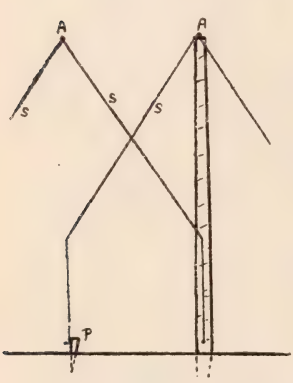


FIG. 6.—End view.

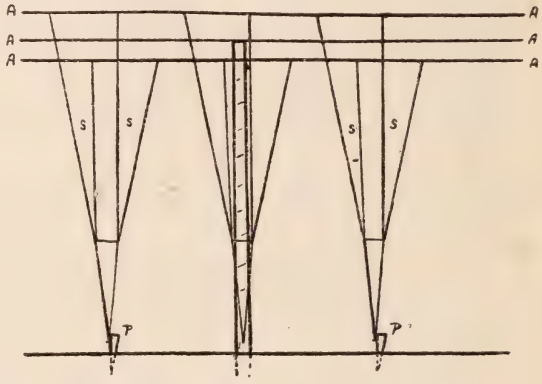


FIG. 7.—Side view.

Cross Butcher System of Training Hops.
AA, string wires; SS, strings; PP, pegs.

Various methods of attaching the string are practised; most commonly the strings are first cut to the required length, then tied to the top wire by men walking upon stilts and finally tied down to the bottom wire or pegs in the ground. In other cases the " continuous " stringing system is practised. In this a hook is fastened to the wire wherever the string requires to be attached, or in the case of pegs a nail is driven in; the operator is provided with a long rod with an eye-hole at the top, through which the running string passes; with this he hitches the string to each of the points of attachment in turn, without cutting the string. The " continuous " string system is more expeditious, but suffers from several disadvantages—the hooks tend to slip, or if a new plan is desired, are not easily moved, and again if wire-work has to be taken down for re-erection the hooks are inevitably in the wrong place; lastly, if a breakage occurs it usually leads to the falling of two or more strings.

A system of stringing widely adopted on the Pacific Coast of America offers some advantages in the case of Worcester work; in this plan the string wires are attached to the cables at the end and to the cross-wires along the length of the alley by means of hooks, so that they can be let down to the ground for stringing and again for picking. The economy in cost of stringing is not great, but the method would save much shattering of hops during picking. It is worth investigating from the experimental point of view at Wye or Malling.

Management of the Growth of Hop-Bine.—In hop-growing nothing is more important than the attainment of a perfect growth of bine so that each string is adequately furnished and produces its quota of ripe hops. Many factors contribute to this end and the hop grower needs to perfect good plans and see them carried out. Perhaps the first point of importance is the maintenance of strong hills. Sir A. D. Hall showed, when he was Principal of Wye College,* the importance of leaving the stem attached to the root till the foliage had died and the reserve food formed by the leaves after picking had been stored in the root-stock, as compared with the alternative practice of cutting off the stems at or soon after picking.

Whilst it is important to maintain the hop hills in a state of vigorous growth, it is equally important that they be not allowed to become overgrown and straggly; for this reason the hills require to be cut during each winter period as described in the first article of this series.†

Pulling.—Pulling is a practice carried out as a means of equalising and regulating the growth of the hop-bines, so that these may produce fine, short-jointed and yet vigorous growth. In most seasons and especially when cutting has been executed early in the season, the hills shoot irregularly, produce a relatively small number of coarse bines and require to be pulled once or twice and sometimes three times during April and early May before they are put to the string. Pulling is also regulated to the strength and vigour of the garden, young hops requiring little or no pulling, while vigorous hops in their third or fourth season benefit by hard pulling. Other factors requiring consideration when deciding to what extent pulling shall be carried out are the characteristics of the variety, the character and richness of the soil, and the length of run which the bines are required to make in order to furnish the strings. Unfortunately

* A. D. Hall, *Journal of the South Eastern Agricultural College*. 1902.
†This *Journal*, January, 1922, p. 891.

from the nature of the case this method of regulating hop-growth can only be carried out at the beginning of the season and little or no effort seems to have been made to regulate growth at any other season save by the amount of plant food supplied. This is not, however, the only possibility. For instance, it would seem that growth might be easily and perhaps more satisfactorily regulated by checking the bines at or about the level of the middle wire—say, 4 ft. high—by breaking off the heads of the strong shoots only. The weaker stems would then grow normally but the broken stems of the strong shoots would produce two or more fine short-jointed side-shoots which could be used to perfect the furnishing of the strings. By this means growth could be accurately controlled at least a month later in the season. It is not suggested that any grower should adopt this suggestion on a large scale without trial, but it seems to be a fertile line for investigation.

Tying usually commences in the first or second week in May, a start being made with the early varieties. The work is best executed by women, though sometimes a gang of boys may be utilised; in any case, it requires to be very carefully supervised or irreparable damage may result. The operation consists in distributing the bines to the strings provided for each hill so that two or three bines, as desired, may be put to each string. Great care must be taken to see that each string to the hill is equally furnished and tying will have to be repeated several times before all the strings receive their quota of bines. As soon as this is done all surplus shoots are pulled out so that growth may be concentrated in those which have been put to the strings. In cases where a hill has died or is very weak and blank strings would otherwise result, extra bines should be led from neighbouring hills to cover these strings in such systems of wire-work as the Butcher, where middle wires are provided.

By the beginning of June all the strings should be furnished and the hops should have reached the middle wire and be growing vigorously; meantime all surplus shoots as well as any runners should be constantly pulled. By the time the heads are beginning to reach the top wire the lowest leaves on the bines are stripped; this operation is carried out chiefly because the lower leaves are inaccessible to the sprayers and so tend to become breeding-grounds for the hop aphis. Stripping is later continued to the height of the middle wire and sometimes a foot or two beyond, but it should not be forgotten that the

stripping of the leaves weakens the vigour of growth, and, consequently, must not be carried too close to the growing point, especially in the case of weak hills.

Training.—The responsibility of the tyer is generally supposed to have ended by the time the heads of the bines have been placed upon the sloping strings, but this does not complete the training; for if the strings have a considerable slope or if windy weather prevails some of the bines are blown away from the strings and require to be replaced. This necessitates frequent trainings at first from the ground or with short steps, and later on by men on stilts or with ladders until the bines have grown over the top wire. This stage with most varieties should be attained by the end of July, at which time training may be said to be complete.

* * * * * *

GLOUCESTERSHIRE OLD SPOTS PIGS.

SANDERS SPENCER.

UNTIL recent years it was not generally recognised that in these islands we had several quite distinct types of pigs which, notwithstanding the fact that no particular and continued attempts have been made to preserve their special characteristics, still retained their peculiar points, which were transmitted generation after generation to their progeny.

One of these, which might probably be termed original types of pigs, was of a black and white or, as it appears to be becoming more every year, a white and black spotted colour, has been found for many years in the County of Gloucester and the adjoining districts. The persistency with which boars of the Gloucestershire Old Spots breed impress their peculiar colour on their progeny, even from sows of other breeds and colour, appears to prove that the breed is actually an original one and not the result of chance or of crossing two or more breeds within recent times. In the first volume of the herd book of the Gloucestershire Old Spots Society it is claimed that if a Gloucestershire Old Spots boar be mated with a sow of any other pure or cross-breed the resultant produce will almost certainly be a litter of pigs of a spotted colour and with the well-known type of ear of the sire. No record is given of the extent to which experiment on this point has been carried, nor whether the crossing of a Gloucestershire Old Spots sow

with a boar of the Large or Middle White breeds would give similar results as to colour, form and hang of ear. This last point is mentioned because it is claimed by breeders of Large White and Middle White pigs that if a boar of either of these breeds be mated with a coloured sow of any other breed, the large majority, if not the whole, of the pigs of the resultant litter will be of the colour of the sire. The two claims might give rise to a discussion on the comparative powers of the respective sires to influence the colour of the offspring. If it be admitted that the boars of the Large White, Middle White, and Gloucestershire Old Spots boars do impress their particular colour or markings on their produce from sows of any other breed or cross, then the claim that a spotted pig is of equally pure a breed as the white pigs must be conceded, just as it is generally admitted that the white pigs named are a distinct breed.

The question as to the original cause or causes of pigs of differing colours being more or less confined in olden times to varying districts has been a subject of keen discussion for many years without any decisive results. The difficulty of discovering a solution to the question has not been so great with regard to pigs of whole or distinct colours, as in these cases the variations may have been due to the differences in the colour of the soil, the herbage, and woods and forests in the different districts in which, in olden times, the pigs roamed in a more or less wild state. The real difficulty arose when an attempt was made to discover the cause of the peculiar markings which appear to be natural to pigs of the Gloucestershire Old Spots, the Sheeted or Saddleback, etc., breeds. To what we can attribute the spotted appearance of the first named and the white mark over the shoulders and down the fore-leg of the latter breed is not clear. Yet the peculiar markings are persistent, so that it would appear that some good and sufficient cause existed in the past for these markings of some breeds of pigs and the whole colour of others.

The causes of the present form, size and quality of the Gloucestershire Old Spots pig appear to be much more readily discovered. As in other districts, the causes have been the requirements of the pig-breeders and of consumers. In some portions of the County of Gloucester the elevation of the farms is high, and consequently a pig of a robust nature was needed. In other portions, especially in the vales, milk production is largely carried on, and within comparatively recent years butter-

FIG. 1.—Young Gloucestershire Old Spots Boar.

FIG. 2.—Gloucestershire Old Spots Sow.

making and cheese-making were commonly followed, so that a considerable number of strong and healthy pigs were required for the consumption of the skim milk and butter milk and the whey. Further, because a very large number of small holdings were in the occupation of a thrifty and hard-working race of farmers, pigs which could be converted into bacon for the summer supply of animal food for the farmers and their large families were equally necessary. Probably it was owing to these, rather than to any other causes that the evolution of the hardy, prolific and quick-growing pig, most suitable for the manufacture of large, thick and heavy sides of bacon, and now termed the Gloucestershire Old Spots pig, was brought about. It may be asked why these qualities should be less persistent now that the conditions have changed, whilst there exists so great a difficulty in retaining points which at the present time are deemed to be necessary, in the pigs of other breeds, in order to command success in the various showyards? One answer which might be given is that these particular characteristics, referred to as being common in the Gloucestershire Old Spots pigs, are more or less inherent and natural to the breed, whereas the peculiar points referred to as necessary for the successful exhibition of pigs of most breeds are mere fancy points, more or less the result of chance, and therefore not natural to the animal and of little or no practical value.

If further evidence of the many good qualities of the Gloucestershire Old Spots pig was required, proof would be furnished by the phenomenal success of the Society established only some 8 or 9 years since. No other pig society has such a record. This wonderful success must have been due to a large extent to the inherent good qualities of the spotted pig, but it could not have been achieved had it not been for the vast amount of successful effort bestowed on the Society by the original Council and the Honorary Secretary of the Society.

The Gloucestershire Old Spots pig has found new homes in most parts of the country, where it has become noted for its hardiness, its quick growth, and its ability to grow into a large fat pig comparatively early in life. These were the qualities amongst others that made it so great a favourite in the county of its origin, and they are still thoroughly appreciated in other districts. Now that the numbers of the particular breed have so enormously increased, however, the pork trade alone will not be able to absorb all the fat pigs produced. In order to give some idea of the great extension of these spotted pigs, it

may be pointed out that the first volume of the herd book, published in 1915, contained the pedigrees of 39 boars and 247 sows, or a total of 286, whereas the seventh volume, published last year, contained the entries of 1,407 boars and 5,382 sows, or a total of 6,789 entries.

So enormous an addition in so short a period to the number of breeding pigs of this particular breed must necessitate the seeking of some outlet for its fat pigs other than the fresh pork trade. The requirements of the bacon curer must be studied so that the surplus fat pigs can find a good market. It is quite possible that the Gloucestershire Old Spots pig, having been bred for so many years with a view to the supplying of the fresh pork markets and the old style of bacon manufacturers, may be in need of some slight alteration in its general character, as the form and degree of fatness of a side of bacon of the present day varies very considerably from one of, say, forty years ago. Length of side of the pig is now most important, and squareness of hindquarters is an indication of a fashionably shaped ham—for, strange as it may seem, there is such a thing as fashion in hams, or a compliance with the needs or fancies of purchasers, irrespective of some increase in the cost. Another point which producers of bacon curers' pigs should study is the fineness of bone, or perhaps it could be more clearly described as lightness of offal. This reduction in the weight of the head, the legs, the tail, etc., affects the pork purveyor and the bacon curer far more than the butcher is affected by the weight of the offals of cattle, sheep, and calves, since in the latter case the offals are given in with the fat animal, whereas in the former instance the offals are purchased at the same price as the body of pork. Reduction in the weight of the bone in the carcass of the pig, therefore, may at first sight appear to affect only the consumer, but its effects are greater, as a manufacturer gains or loses credit by his success or failure to satisfy his customers by furnishing to them an article which best answers their purpose. The object in calling attention to various points in these articles is not for the purpose of criticism, but to offer suggestions which in the writer's opinion might, if adopted, prove of benefit to the admirers of the different breeds of pigs. What is termed by the Gloucestershire Old Spots Society as "a standard for a typical G. O. S. Pig" is as follows:—

Head—Medium length and wide between the ears, nose wide and medium length, slightly dished.

Ears—Rather long and drooping.

Jowl—Medium size.
Chest—Wide and deep.
Shoulders—Well developed, but not projecting, and in line with ribs must not show any coarseness.
Back—Long and level.
Loin—Very broad.
Sides—Very deep and presenting straight bottom line.
Belly and Flank—Full and thick.
Quarters—Long, wide and not drooping.
Tail—Set high, of moderate size, yet fairly strong and long carrying brush.
Hams—Large and not flat and well filled to the hocks.
Legs—Short, straight and strong.
Skin and Coat—Skin light or dark, must not show coloured splotches otherwise than beneath the spots of the coat, the latter should be fully and fairly thick, hair long and silky but not curly, with an absence of mane bristles. Colour: white spots on black ground or black spots on white ground. Such spots to be of medium size.

Objections—Head narrow, face and nose dished.
Ears—Thick, coarse or elevated.
Coat—Coarse or curly with rose; bristly mane or decidedly slate or sandy colour; skewbald or saddleback markings.
Wrinkles—Highly objectionable, almost to disqualification.

Quality to be especially considered by judges.

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THE SPRAYING OF CORNFIELD WEEDS WITH SULPHATE OF AMMONIA.

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THE object of the trials described below was to discover an alternative to copper sulphate solution as a spray for destroying charlock and other weeds in corn fields.* For several years past a 3 per cent. solution of copper sulphate (30 lb. copper sulphate to 100 gal. of water) has generally proved effective for this purpose,[1] and from the point of view of killing charlock it is

* Reports on the spraying of charlock and other weeds have recently been received by the Ministry from a number of centres. They include accounts of trials with sulphate of ammonia furnished by Mr. R. C. Gaut (Agricultural Organiser for Worcestershire) and Professor R. G. White (University College of North Wales, Bangor.) The numeral references indicate notes at the end of this article which have been prepared from these two reports by officers of the Ministry.

very satisfactory. It has, however, two drawbacks, viz :—(*a*) copper sulphate is poisonous and on this account requires to be used with care, and (*b*) although it does not kill the cereal crop, it checks it, as a rule, with the result that the crop may require stimulating subsequently with a suitable nitrogenous manure.

It would, however, be a great step forward if some material could be found which would have the dual effect of killing the charlock, etc., and at the same time stimulating the cereal crop. Fortunately, there is reason to believe that a solution of sulphate of ammonia possesses this dual effect, as will be gathered from the experiments referred to below.

Herefordshire Experiments.—When the writer was Agricultural Organiser for Herefordshire, one of his Committee had a crop of winter wheat which was being over-run with the Corn Buttercup (*Ranunculus arvensis*), and he was particularly anxious that some means of dealing with it effectively should be discovered. Some French experiments showed that a solution of sulphate of iron was slightly more effective than a solution of copper sulphate.

Sulphate of iron, however, was difficult to get at that time (1920), and as a strong solution had been used (about 15 per cent.) the cost would have been prohibitive. Bluestone (copper sulphate) was therefore used. At the same time, seeing that some of the highly soluble nitrogenous manures burn the leaves of crops under certain conditions, it was decided to test the effect of solutions of nitrate of soda and sulphate of ammonia. The strengths of solutions used were as follows :—

(*a*) Copper Sulphate 3 per cent. solution.

(*b*) Nitrate of Soda—1 cwt. dissolved in water and made up to 60 gal.

(*c*) Sulphate of Ammonia—1 cwt. dissolved in water and made up to 60 gall.

(*d*) Sulphate of Ammonia—2 cwt. dissolved in water and made up to 60 gall.

Nitrate of soda was not easy to dissolve completely in water owing to the large size of its crystals. It was, therefore, a little troublesome in blocking up the spray nozzles, and further the solution acted on the rubber tubing, causing it to collapse. Sulphate of ammonia, on the other hand, dissolved rapidly in water and did not tend to block up the spray nozzles when previously strained through an ordinary bag.

The results of these trials were that the *copper sulphate spray* had the usual burning effect on the Corn Buttercup[2] with a slight burning effect on the leaves or " flag " of the wheat. *Nitrate of*

soda had very little burning effect on the Corn Buttercup leaves and in a few days was pushing on both the Buttercups and the cereal crop. The stronger solution of sulphate of ammonia was much more effective than the weaker spray in checking the Buttercup, and within a week its stimulating effect on the wheat crop was quite obvious. The yellowish colour and stunted appearance of the wheat on the plot sprayed with copper sulphate solution was very pronounced as compared with the much greener and taller plant on the sulphate of ammonia and nitrate of soda plots.

Experiments with Sulphate of Ammonia in Bucks.—During 1921, in connection with the Bucks Agricultural Instruction Sub-Committee, the writer had further opportunity of testing the effect of sulphate of ammonia solutions. Centres were selected for this purpose in different parts of the county, each plot being about 1 acre in extent.

An ordinary " Strawson " charlock sprayer was used, and conveyed from centre to centre in a Ford van. The pump, spray barrel and spray bar were fitted into a farmer's cart. The spray fluid was made as follows[3] :—Approximately 40 gal. of water was poured into a wooden tub of about 60 gal. capacity, then a 2 cwt. bag of sulphate of ammonia was shovelled in with a spade, each spadeful being given a shake so as to distribute it in the water. At the same time another man kept stirring the solution with a stout pole. With sulphate of ammonia in good condition, it was practically all dissolved by the time the bag was emptied. The sulphate of ammonia appreciably increased the volume of the solution, so that much less than 20 gal. of water had to be added to bring the volume up to 60 gal. This needs to be borne in mind, as one would obtain a weaker and less effective spray fluid, by adding 2 cwt. of sulphate of ammonia to 60 gal. of water.

Careful notes were made of the effect of the sulphate of ammonia spray on all the weeds which happened to be present in the cereal crops, and a good deal of information has been gathered in this way.

It should be remembered that last year was abnormally dry, very little rain falling in Bucks from the beginning of the year till harvest time. Hence the weeds were tougher and more difficult to kill than usual, while the stimulating effect of the spray on the cereal crop was not nearly so marked as was the case in 1920, largely because there was practically no reserve of soil moisture to keep the cereal crop going. The usual

smothering effect of the cereal crop therefore was not so apparent and this gave the weeds a unique opportunity of reviving, where they were not absolutely killed out.

Effect of Sulphate of Ammonia Spray on Various Weeds in Bucks.—The spray fluid was 2 cwt. of sulphate of ammonia dissolved in water and made up to 60 gal.[4]

GROUP I.—SPRAY EFFECTIVE IN 1921.

Charlock (*Sinapis arvensis*, Linn.).—This particular weed was not very common in spring-sown cereals during the past season in Bucks, although one very like it in many respects was abundant, as is explained below. However, at those centres where it was present, the spray destroyed the charlock satisfactorily.[5]

Wild White Mustard (*Sinapis alba*, Linn.).—This plant is easily confused with ordinary charlock in its earlier stages of growth; but the pod is very distinctive. The beak of the pod is longer and broader than the rest, whereas in charlock the beak is shorter than the rest of the pod. This was the prevailing cornfield weed in the Chiltern Hill district. It was sprayed at some centres immediately it came into rough leaf, whereas in others it had got into full flower. However, the leaves were badly burnt, the flowers destroyed and seeding very largely prevented. At both stages the spray was most effective.

Ivy Leaved Speedwell (*Veronica hederæfolia*, Linn.).—This weed was common in some of the cornfields in the Vale of Aylesbury. On account of its spreading habit it tends to smother the young cereal plants. The spray appeared to destroy this weed completely.

Sheep's Sorrel (*Rumex Acetosella*, Linn.) was only common in one or two centres. The spray fluid appeared to be quite effective in destroying it.

GROUP II.—PARTIALLY EFFECTIVE IN 1921.

Corn Buttercup or *Starveacre* (*Ranunculus arvensis*, Linn.).—This weed was fairly common among winter wheat on the stretch of land extending from Stony Stratford to Chaddington. It grows up to 18 in. high, has a smallish yellow flower and black spinous fruits. In Herefordshire these black fruits are called "harvest lice," and the spines do undoubtedly suggest legs.

When these plants were sprayed during the earlier stages of growth,[6] the leaves were withered up and it appeared for two or three weeks that the plants were quite destroyed, but after this time a proportion of the weeds recovered, and ultimately produced seeds. The spray, therefore, was not quite so effective under

the abnormally dry conditions of 1921, and further trials are necessary to see if the spray is more effective in a normal season, as was the case in Herefordshire in 1920.

Other Buttercups, named "Crazies" locally, included the Creeping Buttercup (*Ranunculus repens*), the Upright or ordinary Field Buttercup (*R. acris*), etc. In these cases all leaves which the spray hit were badly scorched, but after about three weeks a good proportion showed signs of recovery.

Dandelion (*Taraxacum Dens-leonis*, Desf.).—All leaves hit with the spray were badly burnt, but, like buttercups, many recovered after about three weeks.

Broad Dock (*Rumex obtusifolius*, Linn.).—In some of the cornfields selected for spraying, docks were fairly common. The spray was very severe on the leaves, and growth was temporarily checked; but after a few weeks the docks began to produce new growth.

Common Field Thistle (*Carduus arvensis*, Curt.).—In this case, wherever the "spray" hit the leaves they were badly scorched, and where thistles had been damaged previously either by the horses' feet, or the cart wheels, they appear to have been killed outright, but the others recovered after two or three weeks.

GROUP III.—ALMOST INEFFECTIVE IN 1921.

Black Mustard (*Sinapis nigra*, Linn.).—This weed appeared to be confined to the cornfields in one parish near Aylesbury. Only one field containing it was sprayed and that after the plants had come into flower. At this stage the plant was tall and possessed long tough stems bearing few leaves. The flowers are small and yellow. The spray fluid burnt the leaves somewhat, but did not destroy the flowers or prevent seeding. Further trials are required to see if the spray will destroy this plant in its early stages of growth.

Black Bindweed (*Polygonum Convolvulus*, Linn.) and *Milk or Sow Thistle* (*Sonchus arvensis*, Linn.).—The spray does not appear to injure these plants.

Stimulating Effect of the Spray on the Cereal Crop.—At one centre, viz., Saunderton, Nr. Princes Risborough, a patch of spring oats, containing Wild White Mustard, was sprayed as follows:—*Plot 1*. No spray. *Plot 2*. 1 cwt. sulphate of ammonia dissolved in water and made up to 60 gal. *Plot 3*. 2 cwt. sulphate of ammonia made up to 60 gal.

The stronger solution (Plot 3) was much more effective in destroying the mustard than the weaker solution on Plot 2, and this in turn compared very favourably with Plot 1.

At harvest time the three plots were kept separate to see whether there was any improvement in the cereal crop owing to the spray. The following are the results:—*Plot 1.* 32 bus. per acre; *Plot 2.* 36 bus. per acre; *Plot 3.* 44 bus. per acre.

Important Practical Points in Spraying.[7]—1. One should insist on having sulphate of ammonia in dry condition for this purpose, as the damp, lumpy grades take much longer to dissolve, and the lumps need to be broken down from time to time during stirring.

2. Always strain the solution into the spray barrel. For this purpose copper gauze is useless, as the spray fluid corrodes it. The best way is to cut open a basic slag bag and strain through one thickness only. The single thickness is very effective in removing any foreign matter from the liquid and in preventing blocking up of the nozzles.

3. Select a dry day for spraying. If the leaves are not dry, the solution is diluted and consequently less effective. Further, the sulphate of ammonia solution dries rapidly on a fine, sunny day. It is this "dry" sulphate of ammonia distributed uniformly over the whole plant, which draws the moisture out of the protoplasm of the cells and, as a result, kills the plant by what is technically called "Plasmolysis." A dry day, therefore, increases the "killing power" of the spray.

4. A calm day is equally important, as it is impossible to cover the leaves of weeds completely in a wind, and the fine misty spray is largely wasted. It also takes considerably more spray fluid to cover an acre, whereas on a calm day 60 gallons should spray about $1\frac{1}{4}$ acres provided one has a good man driving the horse.

5. Although Charlock can be killed after it comes into flower it is much better to spray it as soon as possible after it comes into rough leaf. The cereal crop then gets the benefit of the manurial constituents of the soil which otherwise would have been taken up by the charlock.

6. Sulphate of ammonia spray fluid has a very corroding effect on the usual charlock spraying machines, which are made of copper or alloys of copper. Chemical action takes place between the copper and the sulphate of ammonia, forming sulphate of copper, and, if the sprayer were not washed out immediately with clear water, the nozzles and pump would soon be choked up with blue sulphate of copper. Possibly this difficulty could be overcome to some extent by lining the con-

ducting tubes and nozzles with lead or tin, although a harder metal would be required for the wearing parts of the pump.

Daisies in Lawns.—At one centre, sulphate of ammonia spray (11 lb. to 3 gal.) was used in order to see if it would destroy daisies. The spray was applied with a " Four Oaks " knapsack sprayer, and it appeared to be quite capable of destroying a very large proportion of the daisies present.

NOTES.

(1) A 4 per cent solution of copper sulphate is generally recommended. See the Ministry's Leaflet No. 63.

(2) "Copper sulphate has no effect upon Corn Crowfoot (Buttercup)" (Worcs.).

(3) "Field trials were carried out (in Worcestershire) on Corn Crowfoot (in autumn-sown corn) against which sulphate of copper is ineffective, and from the results the following is recommended :

Strength : Sulphate of ammonia 1¼ cwt. in 40 gallons of water.

Amount of solution per acre : 60 gallons " (Worcs.).

(This is nearly 2 cwt. in 60 gallons).

If the operation is well carried out in favourable weather at least 75 per cent. of the corn crowfoot will be killed and most of the remainder so damaged that they will have insufficient vigour to produce seed (Worcs.)."

(4) "In the course of spraying experiments with sulphate of ammonia (in Worcestershire) it was discovered that it had injurious effects upon a much wider range of plants than has sulphate of copper. At the above strength and rate per acre it will exterminate almost completely ivy-leaved speedwell, large field speedwell and corn spurrey or dither if young (the latter at half strength) ; charlock, radish, common hemp nettle, and many other annuals are also destroyed to the same extent as corn crowfoot, the spray thus being in the case of these plants not quite so deadly as sulphate of copper. *Peas, beans, vetches and potatoes are all severely injured and clover seedlings are killed. The operation must not therefore be carried out in the case of corn which has been seeded out with clover.*"

(5) As regards the comparative efficacy of sulphate of ammonia and sulphate of copper against charlock the following are the conclusions of the Bangor report :—

(*a*) Spraying Charlock with 4 per cent. sulphate of copper solution is much more effective than with concentrated solution of sulphate of ammonia.

(*b*) The effect of sulphate of copper is more immediate, and, whereas sulphate of ammonia solution only attacks the leaves and to a lesser extent the flowers, sulphate of copper destroys the leaves, flowers and stem.

(*c*) Sulphate of ammonia solution of strengths 2 cwt. or 1½ cwt. to 60 gallons, causes beans to wither.

(*d*) Sulphate of ammonia solution is capable of destroying Charlock if the spraying is done sufficiently thoroughly to cover the whole of the plant. This is not necessary with sulphate of copper spraying.

(*e*) Spraying with the concentrated solution of sulphate of ammonia causes some of the corn to wither (about 5 per cent. in these observations). Thistles also receive a severe check, their leaves withering completely; they recover in a few weeks, but not sufficiently to mature before harvest.

(6) "As a general rule the growth of corn crowfoot seedlings keeps pace relatively with the corn; in other words, when the season is an early one both weed and crop are forward, while in a late season they are both late. The best period for spraying may consequently be during the latter half of March or the early half of April. The seedlings under these conditions will be about 2 inches high with three or four leaves, thus exposing sufficient surface to catch the spray" (Worcs.).

(7) The Worcestershire report insists on the need for absolute cleanliness of water and vessels used. There must be no risk of foreign matter blocking the sprayer. The spray must be directed so as to hit the plants with force, not merely allowed to drift on to them.

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POSSIBILITIES FOR FRUIT GROWING IN THE NORTHERN COUNTIES.

G. P. BERRY,
Ministry of Agriculture.

AN indication of the districts in which fruit growing might be successfully undertaken may be obtained from the geological character of their soils. Starting with the County of Cumberland there is in the Penrith district a Red Sandstone formation which is highly suitable for fruit growing. It is a soil of good substance and produces high colour in small fruits and apples, and the valley of the Eden on this formation presents many aspects which are most suitable for fruit growing The Slate formations of the county are not very suitable for apple growing, although there are favoured spots even on this formation. The Limestone formation extending from Penrith across the county also presents possibilities where the Millstone Grit crops up. On the coal measures in the west of the county, fruit can also be successfully grown, especially on the margins where the coal measure formations meet the Limestone and Sandstone formations; here, as in some southern counties, the blend furnishes an ideal medium loam. Around Carlisle, where the Lias formation meets the Keuper Marl, some excellent fruit-growing soil is produced.

On entering Westmorland the Shale formations predominate, but in many districts the weathering has produced a soil on which fruit can be grown (Westmorland, Damson).

The climate of Cumberland and Westmorland up to 700 and 800 ft. is quite suitable for all classes of small fruits and apples. Travelling eastward into Northumberland across the Limestone formation the Hexham area is reached, and where the Millstone Grit and the Limestone formations meet, as around Hexham, an ideal fruit soil is again produced. This blend extends past Corbridge until the coal formation is again reached, and where these meet as good a fruit soil is again produced. The Millstone Grit and the Boulder Clay then extend up north with the heavier soil on the east and the Millstone Grit on the west, until the Morpeth district is reached. All along this stretch there are unions of these formations producing narrow strips of good fruit-growing soil. When the Morpeth district is passed the Millstone Grit and the Boulder Clay are still side by side as far north as Warkworth. The Limestone formation then appears and this extends right up to the Scottish border. On the lower elevations of the Limestone formation fruit can be successfully grown, provided the necessary shelter can be obtained.

Coming back south into Durham the same formation is continued, viz., the Boulder Clay and the Millstone Grit, and there are portions where a good blend is again met with as at Staindrop, Raby, Barnard Castle, etc. There are also tracts of alluvial soil in the valleys of the Wear and Tees which are suitable for fruit growing.

In Yorkshire the Millstone Grit crops up in pockets amongst the Limestone and produces suitable fruit-growing soils.

Shelter.—This is one of the greatest factors in fruit growing in the northern counties, and in most cases, unless the configuration of the land rules otherwise, shelter is necessary on the north, north-east and east. Much damage is done in the north by the rays of the bright morning sun striking open blossom. Protection from the south-west in summer and autumn is also valuable where fruit is likely to be exposed to strong winds.

In short, although the northern counties cannot be classed as fruit-growing counties in the same sense as Kent, Cambridge, Norfolk, Lincoln, Worcester and Hereford, there are many parts where apples may be successfully grown, and as regards small fruit, results can be obtained superior to those produced in the south. The great drawback to small fruit in the south is the extremes of climate with regard to rainfall. Prolonged droughts occur and ruin the best prospects. These droughts are never so severe in the north, while the night dews are heavier and the general atmosphere more humid.

Varieties.—There have been few varieties of apple, pear or plum introduced in recent years which have been accepted commercially and extensively planted by growers. This is no doubt largely due to the fact that there has hitherto been no means of testing the commercial merits of new introductions, but steps are being taken to remedy this by an endeavour to establish a national testing station where not one tree but a considerable number will be grown under commercial conditions in the open. In the Morpeth and Hexham areas there is urgent need for a commercial experimental plot where varieties of small fruit and apples can be tested and brought to the knowledge of local growers.

At present it is difficult as well as risky to suggest new varieties to growers, but the following should be tried in the north: Apples:—James Grieve (dessert), Roseberry (dessert), Cutler Grieve (dessert); Plum:—Purple Pershore; Pear:—Conference; and Damson:—Aylesbury Prune.

Few of the modern varieties of raspberry, black currant or gooseberry are grown, and the probable reason is the fact that growers are afraid to plant without having seen them tested under local climatic conditions. In the case of gooseberries no district can excel the Wansbeck Valley for quantity and quality. The variety Leveller should be introduced, and it would in all probability furnish a high-class dessert fruit which could be tastefully packed and graded and sold in the popular coast towns in the height of the holiday season on the lines adopted by the Sussex growers in the south coast towns.

Mr. Anderson, the Horticultural Instructor for Cumberland and Westmorland, has found, mainly from plots laid down by the writer over 20 years ago, that the following varieties of apples can be safely planted: Lane's Prince Albert, Bramley's Seedling, Royal Jubilee, Queen, Scotch Bridget, Schoolmaster, Bismarck, Barnack Beauty, and Lord Derby.

The finer quality dessert apples are uncertain in the open, and Cox's Orange Pippin should not be planted north of the latitude of York.

A large local culinary apple known as Royal George is to be found in almost every farm orchard in Cumberland, and is certainly worthy of further consideration on demonstration plots where it might be improved by working on approved types of paradise stock.

In Northumberland, Mr. Mayhew from similar plots has found that apples can be successfully grown even at 1,000 ft. above sea

level. The most suitable varieties are : Domino, Bramley's Seedling, Bismarck, Lane's Prince Albert, Golden Spire and Cox's Pomona. The last-named variety is the best dessert in the open in Northumberland.

Distances to Plant.—The day has passed when the stereotyped distances given in text books should be followed. The distances must be governed by the varieties and the stocks on which they are grown.

Bush Bramley on the paradise requires 18 ft. each way, some others 15 ft. and some of the very weakest 12 ft. Bramley as half or full standards should have at least 40 ft. each way, and there are instances in the south of Bramley meeting after being planted 60 ft. between the rows.

From what we have learned in connection with small men starting fruit holdings, everything points to the necessity of having wide distances between the rows, so as to admit of vegetables or small fruit, and, what is more important, horse and implement cultivation. Moreover, if the fruit grower plants in rows wide apart he can eventually fill up when capital will admit.

All bush trees planted should have a leg of 2 to 2½ ft. to facilitate cultivation and banding.

Pollination.—Although too much importance should not be attached to this subject it has been clearly proved that many varieties of apple do not readily set their blooms with their own pollen, but are dependent on the pollen of some other variety. This being the case it is always safe practice to have three or four varieties in a commercial plantation, and these should be intermixed in preference to being planted in blocks.

Taking all commonly grown varieties of apples, the blooming periods will be found to overlap so that if weather is favourable there is every chance of cross-pollination being effected, and the closer the different varieties are mixed the more likely is pollen to be distributed during brief spells of favourable weather in a season unfavourable for pollination. It is also quite evident from experiments carried out that some varieties produce a more potent pollen than others for cross-fertilisation purposes.

Manuring of Fruit Crops.—Although fruit trees planted on good land may be expected to grow strongly and bear crops of fruit for a period of years there usually comes a time when it is necessary to apply manure. There are many plantations in the country to-day which have come prematurely to a standstill owing to soil exhaustion.

At present there is little reliable information with regard to the manuring of apples.

An extensive experiment was laid down nine years ago at the College garden of the East of Scotland College of Agriculture, Edinburgh, and it was inspected by the writer a short time ago. Some of the plots are most interesting and seem to prove the vital part played by phosphoric acid and potash in fruit production. On the phosphate and potash and on the combined phosphate and potash plots the fruit was larger and better coloured and the crop on the whole heavier as compared with the nitrogen plot.

Where the trees are young and have ceased to grow, some form of nitrogenous, preferably organic, manure must be used. This may be either good farmyard, stable or pig manure. Where none of these is available "shoddy" is probably the best substitute, but even artificials like sulphate of ammonia may be used with advantage. A dressing of 10 tons of good farmyard manure or one ton of shoddy or 1½ cwt. of sulphate of ammonia per acre will help plantations which have ceased to grow.

Where the trees are vigorous and growing but not fruiting heavily 6 cwt. of basic slag of good quality and 2 cwt. of potash salts (20 per cent. K_2O) per acre may be given in autumn. Where the land has sufficient lime the slag may be replaced with advantage by 2 cwt. of steamed bone flour per acre.

As to the best time to apply manure to fruit trees, other than liquid applied while fruit is swelling, there still remains considerable diversity of opinion. The Scottish raspberry experiments and the experience of some expert growers in the south, combined with the general findings of fruit growers under glass, would seem to point to the advantages of autumn manuring as against winter and spring applications. The writer has long been an advocate of manuring in autumn before the leaves have fallen and root action has ceased. This autumn manuring appears to be the only feeding which can influence the formation of fruit buds where such have not already formed, and where they have formed the store of elaborated sap will be increased and a strong healthy bloom secured for the coming season.

Spraying.—The importance of this operation cannot be over emphasised. Upon it is dependent the possibility of producing clean fruit and thus competing with foreign imports. During the late war some pests which were to some extent controlled in pre-

war times multiplied to an enormous extent, notably the winter and March moths.

The most efficacious remedy for all the leaf-eating caterpillars is spraying with arsenates of lead and zinc before the bloom opens and after it has set at the rate of about 1 lb. to 16-20 gallons of water.*

It is also of importance that the trees should be washed with a cleansing wash during the resting period. Many good washes are obtainable, such as standard lime-sulphur, caustic soda and pure lime wash.

The last has many advantages to recommend it. It is readily obtainable and easily made up, the operator can always see where he has sprayed, and there is little danger of missing portions of the trees and bushes. Observations and experiments seem to prove that the later the pure lime spraying is deferred the better the results. Information on spraying is given in the Ministry's Leaflet No. 352 (*The Control of Pests of Fruit Trees in Gardens and small Orchards*).

The lime is washed off by rain later in the season but in many districts it is a valuable addition to the soil and must have a beneficial effect as affording a base where soils are already very acid and in need of lime.

One of the worst enemies of the apple grower of to-day is the capsid bug,† an insect which punctures the fruit at an early stage rendering it unsightly and unsaleable when mature. This insect has already appeared in the north. The only wash which has yet been found of any service against this pest is nicotine and soap and the spray must strike the insect to kill. In the south much harm is being done and the pest is spreading. Successive broods appear and several sprayings are necessary where the pest has once got established.

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TRIALS OF SPRING CABBAGE.

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THE growing of spring cabbage for market is a very important industry in the county of Holland (Lincs). The crop is frequently a very profitable one, but occasionally there is a slump in the market, as in the spring of 1920, when many acres were ploughed under in this district.

* See Leaflets Nos. 263, 264.

† See Leaflet No. 319.

Many hundreds of acres are annually grown in the county. Both soil and climate are particularly suitable for spring cabbage, as indeed for all kinds of the Brassica family. The crop is usually a " catch " crop following on after early or second early potatoes, and not infrequently is followed again by potatoes. The crop is not in every case left to mature, or produce hearts, but may, if the field is required for another purpose, be cut and sold as " Greens." There is, fortunately, a demand for this class of cabbage in certain markets.

Spring cabbage growing is fairly well confined to certain districts throughout England, such as the Evesham Valley, Middlesex, and the Holland Division of Lincolnshire. Certain varieties appear to be favoured in different districts. For example, the bulk of the crop in the Holland Division is of the Offenham variety: in other districts other varieties are grown. Many of the large growers in the Holland Division have their own specially selected strains, and grow seed from selected plants each year.

Purpose of the Trials.—There are very many varieties of spring cabbage, many of which would appear to be only strains of well-known varieties, and hardly worthy of a different name. Many of these varieties are inferior from a commercial point of view to well established varieties.

Trials were started in the first place (*a*) to test the hardiness of varieties, (*b*) to compare the yields and earliness of varieties. About 24 varieties were grown, seed being obtained from different districts in England and Scotland, the popular varieties in each district being included.

Cultivation.—A few notes on the cultivation of spring cabbage as carried out in the trials may be of interest.

Date of Sowing.—The varieties reported on were all sown on 23rd July, from which date to the end of July is the usual time for sowing in the Holland district. It is generally acknowledged, however, that in certain other districts spring cabbage must not be sown until August. Generally, it may be said that the earlier the sowing the earlier can the crop be cut, but too early sowing usually tends to a high percentage of " bolting," and it is strongly held in this district that the seed must not be sown before the 23rd July.

The date of sowing may again depend on the variety. Varieties of the York type are never sown in the northern districts until August is well advanced. Rather curiously, how-

ever, sowings of "Leeds Market" made in July and August both showed a tendency to bolt.

Treatment of the Land.—The field used for the trials has the reputation of being a bad one. The previous crop—potatoes—was nearly a failure, but an excellent crop of cabbage was secured. The land was ploughed after the potatoes were lifted and then worked down. Planting was commenced on 28th September and continued for about a week. The plants were put out in rows 2 ft. apart, with 1 ft. 2 in. between the plants. The usual spacing is 1 ft. 6 in. by 9-12 in., but the extra width between the rows was necessary to allow the horse hoe to be used, as the land produced a large amount of chickweed.

All varieties were planted at the same distance apart. The larger sorts, such as Early Market, completely covered the ground at the distance allowed, but the smaller sorts, such as Harbinger and Redbraes Early, did not half cover the ground. Commercially, of course, the more plants that are set out per acre, consistent with securing good cabbage, the more profitable will the crop be. It is not uncommon for plants to be set out 1 ft. by 6 in., but cabbages of good size are rarely obtained, the crop being cut when half hearted.

Manuring.—No farmyard manure was applied to the cabbage crop. Soot, at the rate of half a ton per acre, was applied in December and 2 cwt. of nitrate of soda was given at intervals from the middle of January, ½ cwt. per acre being applied at each dressing. This appeared ample for the crop, as it finished particularly well. The amount of organic matter in the field was, however, very high.

Hardiness of Varieties.—It was thought that the district in which the seed was saved might have an influence on the hardiness of varieties. As previously mentioned, seed was therefore obtained from different districts. No difference was, however, noted in the hardiness of the varieties grown. The winter of 1920-21 was very mild, only one short spell of frost occurring in December. This frost was very severe, and may have been the cause of the high percentage of "bolting" which occurred in certain varieties. Recurring frosts and thaws would no doubt destroy more plants than a continued severe frost, but severe frost might cause "bolting."

The percentage of "bolting" is given in the table at the end of this article. Further trials are being carried out to test varieties for hardiness.

Earliness.—The date on which the different varieties were ready for cutting is shown in the table. It will be noticed that there is a very considerable difference in the dates of cutting.

The earliest varieties were April, Harbinger and Redbraes Early. These were first cut on 29th March. The bulk, however, of April was several days later than the other two varieties. Early hearting is of great importance for the first cuttings, as prices usually run high at the beginning of the season. It has been mentioned that Offenham is the popular variety in the Holland area. In the trials Offenham and varieties of the Offenham type were generally three weeks later than the varieties mentioned.

A considerable amount of further investigation is here required. For instance, in the first place has the district in which the seed is saved any influence on the resultant crop. Again, supposing seed of the same variety was obtained from different districts, the question of selection comes in. There is undoubtedly a very great difference in the strains of any variety. It would almost appear to be necessary to select one's own strain, and send the seed to different districts to be grown, the seed then being returned here for trial.

Yield per Acre.—The yields per acre are not given, as many of the dwarf sorts should have been planted closer. Any figures given therefore would not convey a true idea of the possible yields per acre. Useful information may, however, be obtained from a comparison of the weight and number required to fill a pot or net.

Remarks on Certain Varieties.—*Flower of Spring.*—This variety behaved very badly in the trials. It hearted very late, and the hearts when formed were not solid, although it is usually reckoned as being very early in hearting, and very free from "bolting." It produced abundant foliage in the late autumn and early spring, and could have been cleared as "Greens" at the end of January. Messrs. Sutton say they have never known this variety to bolt to any extent, nor have they known it to heart so late, and I have myself usually found this variety, when true to name, to throw very few "bolters." It is, however, noteworthy that seed of Flower of Spring obtained from another source and sown a month later behaved in exactly the same way as the earlier sowing. The behaviour of this variety is being watched with interest in the 1922 trials.

Harbinger and Redbraes Early.—These varieties are very dwarf, the latter being much smaller than the former. If plants were put out very close together an early and heavy crop would be obtained.

Large Early Market.—One of the best mid-season varieties, producing large solid hearts. Sixteen to eighteen cabbages filled a pot.

McEwan's Early.—This old variety was also one of the outstanding varieties. It was cut about the same time as Large Early Market. The hearts are not so large but more solid, and the colour is very good. Most of the growers who visited the trials were struck with the excellent appearance of this very old variety.

Offenham.—Several strains of this variety were grown. One strain obtained from a private grower in Evesham was a long way ahead of the others. The importance of getting a proper strain cannot be too strongly emphasised.

Mein's No. 1.—This variety is an old one. It produced good plants early in the year, and at one time gave promise of being amongst the best. It did not, however, heart up as well nor as early as expected. It would probably be a good variety for cutting as " Greens."

Varieties of the York Type.—Varieties of this type such as Leeds Market, would not appear suitable for this district. They are sown in the northern districts in August for hearting in early summer.

Other Varieties.—A number of varieties were omitted from the first sowing, owing to lack of room. Of these Wheeler's Imperial, Market Garden, and Early Wonder may be mentioned as showing promise. They produce small solid hearts. Not being included in the first sowing they were not tested for earliness.

Varieties for Cutting as " Greens."—There is a considerable trade for young half-hearted cabbage in the early spring, and frequently fields are set out for cutting for this purpose. Plants are set out very close together, and the field can be cleared early in the year, in order to prepare for another crop. Varieties required for this purpose must produce a large amount of foliage, yet must not be too loose growing.

Mein's No. 1 and Leeds Market might be suitable for this purpose. Flower of Spring, if it behaves in further trials as it did in 1921, would also be suitable. Leeds Market is of the

York type, and throws rather elongated open foliage. Further tests, however, are being made.

Variety.	District in which Seed was saved.	When Cut.	Percentage of "Bolters."	Average weight per Net or Pot.	Average No. per Net or Pot.
			per cent.	lb.	
Flower of Spring	Essex	28th April...	60	—	—
April ...	Essex	29th March	—	40	30
Harbinger	Essex	29th March	—	40	32
Favourite	Essex	6th April	5	42	27
Edinburgh Market	Lothians	6th April	2	42	24
Market	Middlesex	18th April...	—	40	22
Large Early ...	Lothians	18th April...	—	56	17
McEwan's Early	Lothians	19th April...	—	48	24
Redbraes Early	Lothians	29th March	—	40	33
Early Feltham	Middlesex	20th April...	5	49	24
Offenham	Middlesex	21st April...	—	48	27
Mein's No. 1	—	21st April...	5	45	24
Knowefield Early	—	21st April...	10	48	24
Ellam's Early	Lincs	21st April...	5	48	25
Manchester Express	Essex	21st April...	—	42	27
Smithfield Market	Essex	26th April...	10	45	23
Leeds Market	Essex	3rd May	90	—	—
Offenham	Evesham	26th April...	—	52	22

The remaining varieties were sown later, and were kept back owing to a fall in market prices. As a result of the dry weather they finished badly, and are not reported on here.

It is exceedingly difficult to lay down anything very definite as the result of one year's trials. It is hoped that these trials will be continued on a commercial scale over a number of years. As a result of the first season's trials many problems have arisen. In addition to the main commercial results, such as yields and earliness, there are other points which require investigation, such as those mentioned in the paragraph on earliness.

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POTATO PINK ROT: A DISEASE NEW TO ENGLAND.

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THE discovery in England of the disease known as Pink Rot adds another name to the already lengthy list of fungus diseases which attack potatoes in this country. Pink Rot was until recently known only in Ireland where, by destroying the tubers, it is capable of inflicting very considerable damage to the crop. The disease and the parasite causing it were described in detail

by Dr. G. H. Pethybridge in 1913.* About two years ago it was detected in Scotland; and during the summer of 1921 outbreaks were discovered at two centres in England.

The fact that Pink Rot was discovered last season does not necessarily imply that the disease then occurred in England for the first time. It is certain that it is not present in the country to any serious extent, but it is equally possible that the wilted tops of plants affected by Pink Rot may have been mistaken for the effects of Blight and that the rotted tubers may have been regarded as due to Blackleg or bacterial decay as the result of some form of mechanical injury. The discovery and prompt identification of the disease is gratifying to this extent, that it shows on the one hand the efficiency of the Ministry's Inspectors in detecting new or rare diseases in the course of their manifold duties, and on the other the keenness of farmers to be fully informed and their wisdom in seeking expert assistance.

The Disease in England.—In addition to the two field outbreaks referred to, a case of Pink Rot detected in England in seed potatoes may first be noted. Seed of the variety Majestic obtained from Scotland was observed by Mr. W. Buddin, the Adviser in Mycology at University College, Reading, to be showing suspicious symptoms. Laboratory examination revealed the presence in the tubers of mycelium characteristic of the group of the Phycomycetes. The fungus was grown in artificial culture, isolated from other organisms, and was identified by means of the characteristic and unusual resting spores as being *Phytophthora erythroseptica*, the fungus causing Pink Rot. Only a very few tubers were affected, the remainder of the bulk being perfectly sound. This was the first occasion on which the Pink Rot fungus has been recognised in this country, and a potential outbreak was averted. A notice as to the disease was circulated to the advisers and inspectors, and various samples of suspicious seed-tubers were subsequently submitted to the Ministry's Plant Pathology Laboratory at Harpenden for expert examination; but these all proved to be suffering from frost or other non-parasitic form of injury.

The next report as to Pink Rot was received at the Laboratory from Mr. J. Jarrett, an inspector stationed at Wellington, Salop, who forwarded several samples of completely rotted tubers from

* On the Rotting of Potato Tubers by a new species of *Phytophthora* : *Sci. Proc. Roy. Dub. Soc.*, xiii (N.S.); 35, p. 529.). Further Observations on *Phythopthora erythroseptica*, Pethyb.: *Ib.*, xiv (N.S.); 10, p. 179. Also in *Journ. Dept. Agr. and Tech. Instr. for Ireland*, Vol. XIII, No. 3, April, 1913. Investigations on Potato Diseases (Fourth Report.)

that county. The fungus when isolated and cultivated developed resting spores of *P. erythroseptica* in the typical manner, thus confirming the Inspector's diagnosis in the field. The variety in this case was Great Scot grown from Scotch seed. The disease was first detected on 22nd August, about five per cent. of the plants in a five-acre field being affected. It was observed to be worse in some parts of the field, especially the low-lying portions. A careful survey of the neighbouring district was made by Mr. Jarrett and the disease was found to be present to a small extent in a number of fields in several of the adjoining towns and villages. In all, six localities were discovered, the variety in each case being Great Scot, the seed being obtained from Scotland. Local opinion indicates that there is some ground for believing the disease to have been present in previous seasons in these districts and that it was not introduced in 1921 with Scotch seed. On the other hand the fact that Great Scot only was affected is rather against this view.

The other case occurred near Stevenage, in Hertfordshire, specimens being submitted by a farmer. The variety was King Edward and was grown on land which had not been under potatoes for five years. The seed was home-saved and the crop during 1920 showed no signs whatever of Pink Rot. The seed therefore was almost certainly not the means by which the disease was introduced. Its origin, however, is probably easy to account for. The field in question had been heavily dressed with "London manure." This contained a large amount of vegetable debris such as cabbage stalks, banana stalks, onion, orange and potato refuse, indicating that the manure was contaminated with street sweepings or even market refuse. There can be little doubt that in this case the disease was introduced with the manure, which contained resting spores of Pink Rot in potato peelings and possibly even diseased potatoes which had been thrown out on account of being rotten. The Stevenage case appeared to be an isolated one, no other affected fields being observed in the neighbourhood. The field in question was three acres in extent, the disease occurring in patches; in the worst parts thirty-five per cent. of the plants were affected. The tops of the diseased plants died down early and every tuber on the roots was completely rotted with a moist rot.

Description of the Disease.—The fungus causes a wilting of the haulm and a moist rot of the tubers, the disease deriving its

popular name from the fact that the cut surfaces of infected tubers quickly turn pink when exposed to the air. It commences when the potatoes are still in the ground and attached to the parent plant, and has been found from the end of July onwards. In most cases the attack in the tuber begins at the heel end, because the fungus enters through the stalk, and it proceeds rather rapidly towards the rose end. Diseased tubers remain firm, but of an india-rubbery consistency, and if pressed exude a quantity of juice, while finally they become completely rotten. They do not, however, develop cavities, as in the case of Blackleg. A characteristic series of colour-changes takes place when affected tubers are cut open and exposed to the air and these form an important character for diagnosing the disease in the field. *A pink colour begins to show a few minutes after cutting, and within half-an-hour the whole of the diseased portion becomes a deep salmon-pink. With an exposure of several hours the cut surface gradually darkens and becomes purplish-brown or nearly black.*

Plants infected with the Pink Rot fungus show also indications of unhealthiness in the foliage, due to the presence of mycelium in the stem and roots. This usually occurs rather late in the season. The leaves become pale green or yellow and ultimately collapse or fall off. The symptoms are on the whole those of a Wilt, though the denuded stem somewhat resembles those which have been severely attacked by Blight. Resting spores of the fungus are found in the underground stems and also in old diseased tubers, and in this way the contamination of the soil is brought about.

The losses caused in some of the western districts of Ireland by Pink Rot may be very considerable, in some cases heavier even than those due to Blight, and are greatest in crops grown continuously or too frequently on the same land.

Conclusion.—The discovery of Pink Rot need not alarm English growers. As stated above, it is probably not an absolutely new introduction, but has now been detected for the first time. Its discovery is, however, of great importance, since if the view be correct that Pink Rot has existed in the country for several years and been regarded as Blight, it is obvious that spraying as a preventive would be a waste of time and money. In Ireland it has been known now for many years but has apparently not spread to any extent, and with proper rotation of crops, care as to seed and precautions as to the use of town

manure highly contaminated with vegetable refuse there is no reason to expect further serious outbreaks. Where Pink Rot has occurred diseased haulms and tubers should on no account be left lying about and especially not allowed to reach the manure heap.

Irish and Scotch growers should take steps to eliminate the disease as far as possible, both from seed and ware crops. The great lesson to be learned is the importance of accurate knowledge with regard to all these diseases both on the part of those whose duty it is to undertake research and of those who grow the crops. Any doubtful cases of this or other diseases will be reported on if specimens are sent either to the Adviser in Plant Pathology at the local Agricultural College or to the Ministry's Pathological Laboratory at Harpenden.

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THE TURNIP GALL WEEVIL.

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THE turnip gall weevil (*Ceuthorrhynchus pleurostigma*, Marsh.) is a small beetle injurious to turnips and cabbages, being the cause of the smooth rounded outgrowths, known as galls, on these plants. The galls are the abode of the young of these insects. These bear no resemblance to their parents and are known as grubs or larvæ. The insect is distributed throughout the United Kingdom and is also found on the Continent.

Description and Habits.—The weevil is about $\frac{1}{8}$ in. in length, and is black above and greyish below. During summer and autumn they may be seen in numbers, but one has to look for them carefully as, in addition to being very small, they always attempt to remain concealed and when disturbed drop into the soil and lie motionless on their backs. They generally feed on the leaves, tender bark, young pods and flowers of turnips and cabbages, and the foliage and flowers of charlock and hedge mustard. They rarely expose themselves and are usually found on the lower surface of the leaves of the plants mentioned above or in the soil at or close to the roots of the plants in the roots of which they lay their eggs.

The egg is a very minute, soft, almost transparent object, and is laid in a cavity drilled by the parent beetle in the bark on the root of the host plant, *see* Fig. 2. One female beetle lays

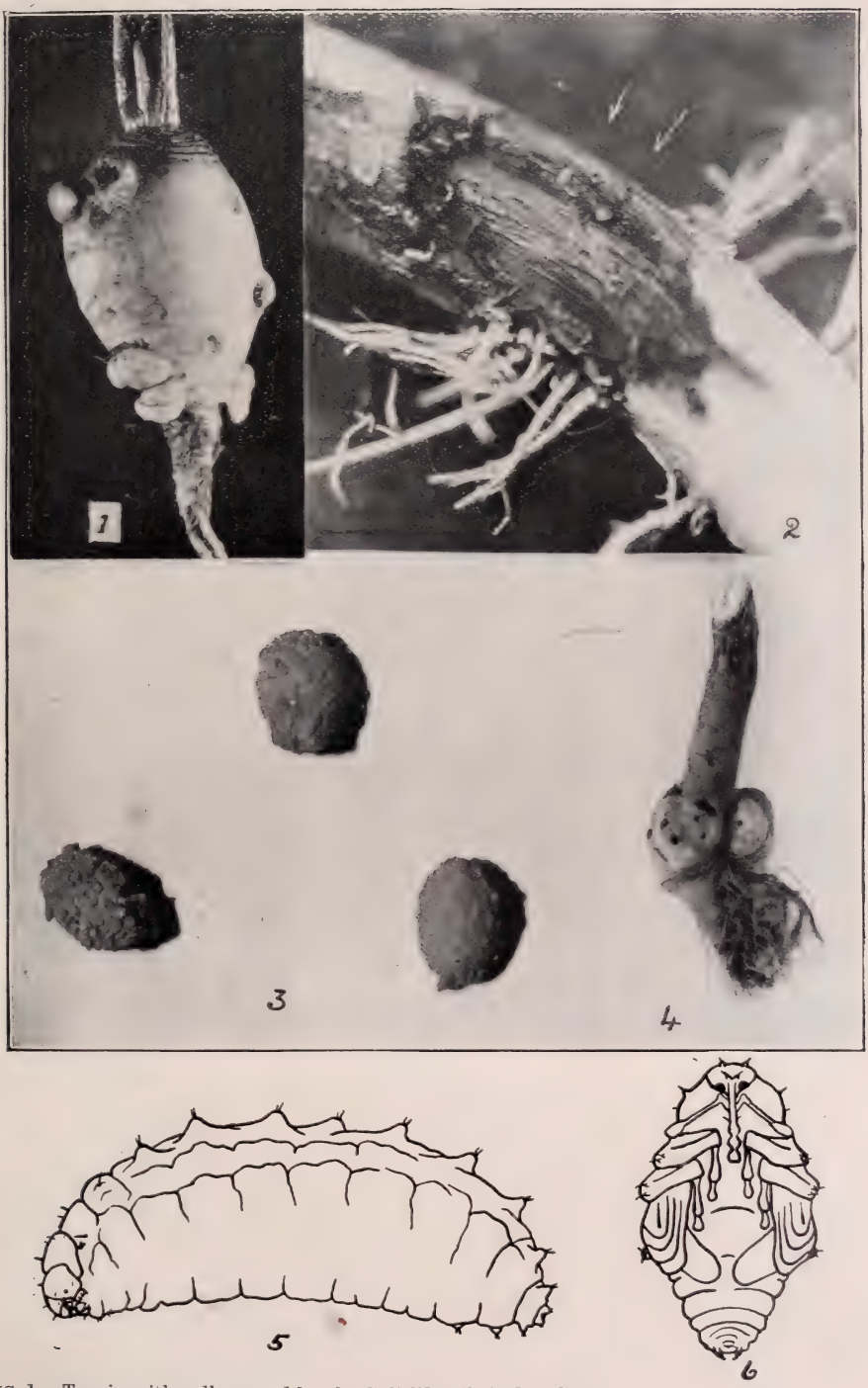

FIG. 1.—Turnip with galls caused by the Gall Weevil (reduced).
„ 2.—Two Weevil Eggs in bark of cabbage stem, indicated by arrow marks, exposed by partly removing the bark (enlarged).
„ 3.—Cocoons made by the Weevil Larvæ for pupation (enlarged).
„ 4.—Galls on cabbage root showing round exit holes of the Larvæ (reduced).
„ 5.—Full-grown Larva of the Gall Weevil (greatly enlarged).
„ 6.—Pupa of the Gall Weevil, ventral view (greatly enlarged).

about one to four eggs per day and may lay a total of about sixty eggs, visiting a number of plants for the purpose.

In a few days the egg hatches and a small legless grub, with a hardened head capsule provided with jaws, comes out. It begins to feed on the inner bark and the plant reacts by growing the knob-like gall around it. The head of the larva is brownish and the body, which is usually held arched in the form of a crescent, is whitish, but may appear yellowish in those that occur in swedes.

When this grub is full-grown (Fig. 5) it bores its way out of the gall through a small round hole (Fig. 4), and goes into the soil. With the aid of a gummy liquid which it produces it then makes a small mud cell (Fig. 3), and transforms inside it into a pupa. These mud cells, known as cocoons, are found among the roots within a depth of about 4 in.

The pupa inside the cocoon (Fig. 6) is the stage in the life-history of the insect when the grub is developing the organs and structures of the adult beetle. When the pupal period is over, the weevil appears, and forcing the cocoon open, finds its way out.

Two Races of the Weevils.—There are two races of these beetles, each producing one brood during the year. One appears in spring and breeds mostly in charlock. The parents die off by summer and the young turn into beetles by August; these adults do not lay eggs at once, but hibernate during the winter and breed in the next spring. This race is not of much economic importance.

The other race, which may be called the summer race, appears in early summer and lays eggs in cultivated crucifers (cabbage, turnips, etc.) of various sorts and dies off by winter. The eggs soon hatch into grubs and these remain in the galls during the winter and pupate in spring. This race is of great importance to the farmer.

Life-History of the Weevils of the Summer Race.—The parent beetles make their appearance about the beginning of June, lay eggs from the end of August throughout autumn, and die off in winter. Turnips in all stages and other plants about six weeks old are preferred for laying eggs in. The eggs hatch in five days or more according to the weather conditions, longer periods being necessary if it is cold. The larvæ in various stages hibernate in the galls during winter, resume feeding in spring, and throughout March and April and one after another leave the galls and pupate. The full-fed larvæ do not bore

out of the gall to pupate except after the soil around has been well moistened by rains. About five to six months are spent in the larval stage. The pupal period varies and is short for those that cocoon late owing to the warmer conditions. The adults emerge late in May or early in June.

Host Plants.—The cultivated plants known to be attacked include turnip, mustard, rape, cabbage, Brussels sprouts, cauliflower, kale, and kohl-rabi.

Natural Enemies.—This insect has various natural enemies. The common garden slug may bore into the galls and feed on the grubs along with the plant tissues. The grub of the turnip mud beetle (*Helophorus rugosus*, Ol.) preys on the weevil larvae and will bore into the galls to get at them. A small parasitic wasp (*Diospilus oleraceus*, Hal.) lays its egg through the gall into the grub and its larva lives inside it, ultimately killing it. Certain birds pick the grubs out of the galls and feed on them.

Methods of Control.—(1) Root out all infested stalks that have been wintered over by the beginning of March, and of spring cabbages as early as possible, and immediately stack them up in large loose heaps. This is the time when the grubs are nearly full-grown and begin to bore out into the soil to pupate. They go into the soil, however, only when it is quite moist and by stacking the stems as advised above the full-grown larvæ are kept back in the first place and as the bark dries quickly they find it impossible to bite through the hard bark to go into the soil. The rest are half grown larvæ and these slowly shrivel up in the bark as it dries. Never leave infested stalks in small lots or scattered about for any length of time.

(2) Plough the land deeply immediately the infested crop has been removed. This operation will crush and destroy numbers of cocoons with the pupæ within. This is very necessary where such crops could not be removed at the early date suggested.

(3) Avoid in the next autumn planting another crop that is likely to be attacked. The summer race lays its eggs from about the end of August through the autumn.

(4) Destroy all charlock and hedge-mustard, as the adult weevils feed on these, and as it may be possible that some of the beetles emerging early from the spring race that breeds in charlock may lay eggs in the cultivated plants in autumn.

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THE FOOD AND FEEDING HABITS OF THE LITTLE OWL.

II.

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EXPERIENCE has shown that in order to arrive at a thorough understanding of the food of any species of wild bird it is necessary to examine the stomach, etc., contents of a large number of individuals, obtained from many localities, and throughout the various months of the year. Prolonged and numerous investigations have convinced the writer that the most reliable method of estimating the different food items is that known as the volumetric system or percentage by volume.

Moreover, such mehods of investigation must be supplemented by field observations, the examination of pellets (where present), the faeces (when necessary), and the food fed to the nestlings.

In the present investigation 212 stomachs of adult birds have been examined from 19 different counties and 23 separate localities. Two of the stomachs were empty and 16 were nearly empty or only partially filled. These are therefore not included, the net number being 194. Of nestlings 18 specimens have been examined and upwards of 260 pellets, while numerous observations have been made on the "hoards" and food brought to the nest.

The counties involved were :—

Bedford.	Kent.	Suffolk.
Bucks.	Leicester.	Surrey.
Devon.	Lincoln.	Sussex.
Dorset.	Norfolk.	Wilts.
Essex.	Northampton.	Yorks.
Hereford.	Notts.	
Herts.	Somerset.	

The number of adult Little Owls examined in this investigation, and the months in which collected, were as follows :—

Jan.	Feb.	Mch.	Apl.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
18	20	21	26	27	22	14	7	0	10	14	15	194

Food of the Adult.—*Animal Food.*—Of the total bulk of food consumed annually by the Little Owls examined 93.49 per cent. consisted of animal matter. The greatest proportion was consumed in November (98.22 per cent.) and the smallest pro-

Monthly percentages of the Principal Food Items of the adult Little Owl.

Kind of Food.	Jan.	Feb.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Averages.
Seeds of Weeds	—	—	—	—	—	1·45	1·07	3·57	—	—	—	—	·55
Miscel. veg. matter ...	11·11	8·00	3·81	5·26	4·33	4·64	6·43	8·58	—	5·50	1·78	6·13	5·96
Slugs	—	—	—	—	—	—	—	—	—	·20	—	—	·02
Injurious Insects	30·78	20·25	43·00	36·92	38·52	26·82	40·36	20·00	—	29·00	19·29	31·87	30·62
Beneficial „	4·55	—	·25	—	3·90	·14	—	·28	—	—	1·43	·33	·99
Neutral „	9·67	28·50	11·52	12·12	14·07	17·41	17·50	19·28	—	26·00	22·14	15·67	17·63
Voles and Mice	31·67	27·75	25·24	26·73	29·25	33·64	19·29	32·14	—	29·30	50·72	35·86	31·05
Wild Birds	8·61	3·00	9·28	5·39	4·63	5·00	2·50	2·86	—	5·00	—	2·67	4·45
Game Birds	—	—	—	—	—	5·59	—	—	—	—	—	—	·51
Earthworms	3·61	11·25	6·20	13·20	5·00	4·50	12·50	12·86	—	5·00	4·64	7·47	7·83
Millipedes, &c.	—	—	—	—	—	·36	·35	·43	—	—	—	—	·11
Miscel. animal matter ..	—	1·25	·70	·38	·30	·45	—	—	—	—	—	—	·28
Totals	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

portion in August (87.85 per cent.). The seasonal variation, however, in diet was much less than in the case of most land birds. (*See* table p. 1134.)

Mammals.—Remains of mammals were found during each month, and in 126 stomachs. The highest percentage occurred in November (50·72 per cent.) and the lowest percentage in July (19·29 per cent.). The long-tailed Field Mouse (*Apodemus sylvaticus*) was by far the commonest species met with, remains being present in no less than 86 stomachs. Remains of the Short-tailed Field Mouse (*Microtus hirtus*) were found in 50 stomachs, the House Mouse (*Mus musculus*) in 9 stomachs, the Brown Rat (*Epimys norvegicus*) in 3, the Red or Bank Vole (*Evotomys glareolus*) in 2, the Common Shrew (*Sorex araneus*) in 3, and the Mole (*Talpa europaea*) in 4.

Birds.—Remains of wild birds were found in 35 stomachs. The total average percentage of wild birds is 4·45 per cent., and of game birds ·51 per cent. The highest percentage was found in March (9·28 per cent.) and the lowest in December (2.67 per cent.). The percentages for the different species are as follows :—

House Sparrow	2·09	per cent.
Starling	2·04	,,
Missel Thrush	·12	,,
Blackbird	·07	,,
Wood Pigeon	·09	,,
Game Birds	·51	,,
Miscellaneous	·04	,,

Reptiles and Amphibians.—Remains of the Common Frog (*Rana temporaria*) were found in two stomachs.

Insects.—Insect food constitutes 49·24 per cent. of the total bulk of food for the year and occurred in 179 stomachs. Examined month by month, the maximum quantity is seen to be taken in July, viz., 57·86 per cent. In August it falls to 39·56 per cent., the lowest for any month in the year.

An analysis of the insect food presents many points of interest. Firstly, of the total average percentage 30·62 per cent. consists of injurious insects and their larvae, ·99 per cent. of beneficial insects and 17·63 per cent. of neutral insects and their larvae. Wireworms and click beetles constitute 16·88 per cent., and are present in all the months of the year. The highest percentage is in March (30·00 per cent.) and the lowest in August 6·57. Weevils or snout beetles form 9·96 per cent. of the total food contents and are taken in the greatest quantity in May (19·59 per cent.), and in the smallest quantity in November (2·50 per cent.). Of the neutral insects the bulk consists of Dung Beetles (*Geotrupes*).

Molluscs.—Remains of the Grey Field Slug (*Agriolimax agrestis*, L.) were found in a stomach in October. This was the only mollusc observed.

Crustacea.—The only traces of Crustacea were those of woodlice, remains of *Porcellio scaber* being found in three stomachs and *Oniscus asellus* in one.

Annelida.—The only annelids that could be identified were earthworms The total average was 7·83 per cent. The highest monthly was 13·20 per cent. in April and the lowest 3·61 in January.

Vegetable Food.—Of the total bulk of food consumed in the year vegetable matter constitutes 6.51 per cent. This consisted chiefly of grass and bits of leaves and .55 per cent. of weed seeds.

Food of Nestlings.—Only 18 stomachs of nestlings were examined. They are, however, of great importance in that they show that the actual amount of insect food is lower than during any other period. The young birds do not seem to be able to deal with beetles, but beetle larvæ and earthworms constitute 18 and 23 per cent. of the food during this period. Voles and mice form 49 per cent., wild birds 10 per cent., and game birds nil.

Examination of Pellets.—Large numbers of pellets (267) from all parts of England were examined. The average weight is 60 grains. They consist almost entirely of animal remains. Of the total bulk 53.5 per cent. consists of voles and mice, insect remains form 41 per cent., of which 17.8 per cent. are of injurious insects, 2.2 per cent. of beneficial insects, and 21 per cent. of neutral species. Young birds are represented by 2.5 per cent. and miscellaneous and unidentified animal matter by 3 per cent. In none of the pellets were any traces of game birds found.

Variation of the Food according to Season.—Even supposing all the charges relative to the destruction of young game birds were true, it is obvious that such food is only available for a comparatively short season of the year. It is therefore important that we should know the exact nature of the food throughout the whole year.

The seasonal variation in diet is much less in the Little Owl than in most land birds, and remains of game birds were only found in two cases and both of these accurred in the month of June. Indeed, of the two specimens one had been fed by the keeper with dead pheasant chicks.

Mammals, injurious and neutral insects and earthworms were found throughout the year, as also a small quantity of vegetable matter.

Variation of the Food according to Locality.—The following table sufficiently explains itself, as showing considerable variations in the food taken by the Little Owl in all the counties involved :—

Relation of Localities and the Number of Stomachs containing Injurious Insects, Voles and Mice, Wild Birds and Game Birds.

County.	No. of Stomachs containing Injurious Insects.	Percentage.	No. of Stomachs containing Voles and Mice.	Percentage.	No. of Stomachs containing Wild Birds.	Percentage.	No. of Stomachs containing Game Birds.	Percentage.	Total No. of Stomachs examined.
Bedford ...	11	38·20	7	22·66	3	3·33	—	—	15
Bucks	5	38·00	3	24·00	2	12·00	1	5·00	5
Devon	9	39·42	7	28·75	2	1·25	—	—	12
Dorset	13	41·20	10	26 33	4	3.66	—	—	15
Essex	9	30·83	7	25·00	3	5·42	—	—	12
Hereford ...	1	70·00	—	—	—	—	—	—	1
Herts	6	36·66	5	18·88	1	2·77	—	—	9
Kent	7	27·50	5	21·50	1	4·50	—	—	10
Leicester ...	7	25·00	6	22·73	1	·91	1	8·91	11
Lincoln ...	8	23 33	12	43·00	—	—	—	—	15
Norfolk... ...	5	35·00	5	26·26	2	8·33	—	—	6
Northampton ...	9	43·33	8	27·92	2	2·92	—	—	12
Nottingham ...	6	32·50	6	30·62	3	11·25	—	—	8
Somerset ...	9	26·66	7	19·66	5	13·00	—	—	15
Suffolk	4	17·86	7	54·71	—	—	—	—	7
Surrey	7	25·42	6	32·75	3	15·42	—	—	12
Sussex	—	—	—	—	—	—	—	—	1
Wilts	8	35·60	7	30·50	1	2·00	—	—	10
Yorks	12	21·94	18	54·44	2	1·39	—	—	18
	136		126		35		2		194

The following statement shows the great variety of Animal Food identified in the stomachs and pellets of the Little Owl :—

Annelida :—
Earthworms (various species).

Arthropoda :—
ISOPODA—
Oniscus asellus, L.
Porcellio scaber, Latr.
MYRIAPODA—
Polydesmus, sp.
INSECTS—
Unidentified insect fragments.
Orthoptera.
Earwig.
Coleoptera.
Unidentified larvae.
Carabus violaceus, L.
Harpalus, sp.
Pterostichus madidus, Fahr.
Pterostichus, sp.
Ocypus olens, Müll.
Philonthus, sp.
Silpha opaca, L.
Aphodius fimetarius, L.
Aphodius, sp.
Geotrupes stercorarius, L.
Rhizotrogus solstitialis, L.
Melolontha vulgaris, Fabr.
Phyllopertha horticola, L.
Elater, sp.
Athous niger, L.
INSECTS—*Contd.*
Athous, sp.
Agriotes sputator, L.
Agriotes obscurus, L.
Agriotes lineatus, L.
Apion, sp.
Otiorhynchus picipes, Fabr.
Otiorhynchus tenebricosus, Herbst.
Otiorhynchus sulcatus, Fabr.
Sitones, sp.
Ceuthorhynchus, sp.
Hylobius abietis, Fabr.
Scolytus, sp.
Hylesinus fraxini, Pz.
Lepidoptera.
Hepialus lupulinus, L.
Hybernia defoliaria, L.
Cheimatobia brumata, L.
Mamestra brassicae, L.
Agrotis segetum, Schiff.
,, *exclamationis*, L.
Triphaena pronuba, L.
Tortrix viridana, L.
Diptera.
Tipula oleracea, L.
,, *paludosa.*
Pachyrhina maculosa, Meign.
Hymenoptera.
Nematus, sp.

Amphibia :—
Rana temporaria.

Aves :—
House-Sparrow.
Starling.
Blackbird.
Missel Thrush.
Chaffinch.
Greenfinch.
Skylark.
Wood Pigeon.
Pheasant.

Mammalia :—
Short-tailed Field Vole (*Microtus hirtus*).
Red or Bank Vole (*Evotomys glareolus*).
Brown Rat (*Epimys norvegicus*).
House Mouse (*Mus Musculus*).
Long-tailed Field Mouse (*Apodemus sylvaticus*).
Common Shrew (*Sorex araneus*).
Mole (*Talpa europaea*).

Summary and Conclusion.—After a very thorough and exhaustive investigation extending over three successive years, and after examining the stomach contents of 194 specimens of adult Little Owls and 18 nestlings, in addition to making careful examinations and analyses of 267 pellets and many "hoards," the author has come to the following conclusions :—

The results obtained by this investigation clearly show, as previously pointed out by Gurney (10) that the losses occasioned to game birds have been grossly exaggerated, and while there is no desire to minimise such in any way, it is urged that the relative seriousness should be clearly understood.

Young game birds are not available as an article of food except for a comparatively short season of the year; moreover, game birds are not bred in every county.

Gamekeepers and others have been appealed to to send in specimens of the Little Owl, and they have very willingly responded, but in spite of the closest and most minute scrutiny to which the stomach contents have been subjected, the percentage of remains of game birds is infinitesimal. Injurious and neutral insects and voles and mice constitute the main items of food.

An examination of 18 stomachs of nestlings gives similar results, while that of the pellets and larders, both by the writer and others, lends no support to the view that large quantities of game birds are destroyed. It is not stated that the Little Owl does not destroy young game birds, for it does, but it is contended that the actual percentage is so small that it is, under ordinary circumstances, negligible. There are no doubt cases where the depredations of a few birds are serious, and of course in such circumstances they should be destroyed.

In consequence of the cumulative evidence obtained we are forced to the only logical conclusion, viz., that whilst a few young game birds are destroyed, the bulk of the food of the

Little Owl consists of injurious and neutral insects, and voles and mice. There is no escape from the conclusion, for it is corroborated and borne out by an examination of upwards of 260 pellets, the stomach contents of 18 nestlings and numerous field observations. Moreover, quite a number of gamekeepers state that they have never seen this bird attack game birds, although living in close proximity to them.

Respecting the value to the agriculturist there cannot, in the writer's view, be any doubt. In sixteen years' experience he knows of no bird (other than the Lapwing) which destroys so large a percentage of click beetles and wireworms. A bird that feeds largely upon wireworms and click beetles by day and voles and mice by night is surely worthy of protection. Even supposing that this bird became much more destructive to game birds than at present, its value to the agriculturist would still more than compensate for the injury.

It is patent to any unprejudiced mind that any policy of destruction is robbing the farmer of a most valuable aid in the destruction of farm vermin and some of the most troublesome crop pests, and it is sincerely to be hoped that they will raise their protest against any such inimical action.

In carrying out this work I have placed myself under many obligations. Firstly I wish to acknowledge the financial assistance given me by the Carnegie Trust for the Universities of Scotland, who have defrayed the major portion of the expenses of this investigation.

I wish to record my thanks to the Editors of the *Field*, the *Gamekeeper*, and the *Shooting Times*, for the wide publicity they have given to this investigation, without which I should have failed to obtain the bulk of material examined. Finally, to the following ladies and gentlemen I am indebted for a constant supply of specimens, pellets and observations and information relating to this species :—

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NOTES ON MANURES FOR MARCH.

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Manure for the Swede Crop.—Few crops have been so much discussed as the swede crop: on many farms it involves the expenditure of more money per acre than any other, and at the same time it is so useful as to justify attempts to secure as large a yield as possible. On good farms the management of the crop is as a rule so satisfactory that the yield is about as high as the season will allow: in other words, the limit is set by the weather rather than by the farmer's efforts. Indeed, in some parts of the country farmers put on more fertiliser to the swedes than the yields justify, thus not only bringing disappointment on themselves but losing the benefit which

might have accrued had the fertiliser been used for some more responsive crop. This matter has been tested by Professor Somerville, and his conclusions are justified by the later Rothamsted work. These experiments show that if the yield of swedes does not run to more than about 15 tons per acre there is no advantage in using both dung and artificials: a farmer may use dung if he can spare it, and then his artificials could go on to some other crop: or, if he could make better use of his dung somewhere else, he could grow his swedes on artificials only, except where the soil is likely to dry out. This is shown in an experiment made at Rothamsted in 1915, when the yields per acre were:—

No manure.		10 *tons dung.*		*Artificials only.*		*Artificials* + 10 *tons dung.*	
tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
9	12	12	18	12	15	12	18

The addition of artificials to the dung gave no increase in yield.

The case is different when the climatic conditions allow of larger crops. In the north of England yields are considerably heavier than at Rothamsted, running to 25 tons per acre or more, and Professor Gilchrist finds that under ordinary circumstances they justify the addition of 4 cwt. basic slag or 3 cwt. superphosphate, as well as 1 cwt. sulphate of ammonia to the 12 tons of good dung per acre.

It is usually safe in manuring to aim at as large a crop as the climate will allow, but also to recognise that fertilisers must not be expected to overcome the effects of the weather.

Muriates or Sulphates as Manure.—Farmers are now offered the choice of muriate or sulphate of potash, and it is possible that they may at a future date be able to obtain muriate of ammonia. Experiments are being carried out at Rothamsted and elsewhere to ascertain the manurial value of these newer substances. Before the War the problem never arose: all the available potash salts came from one source and it was no advantage to the farmer to obtain muriate rather than sulphate. Nowadays, however, there is more than one source of supply, and the possibility of competition accordingly exists. It is therefore imperative that the relative values of the two substances should be carefully and impartially tested. This is being done, but as everyone familiar with agricultural experiments will realise, the tests must go on over several seasons before anything very definite emerges.

There already exists, however, a certain amount of information which may easily prejudice the matter because it is not strictly

applicable to farming practice. In laboratory experiments muriates have sometimes done a certain amount of harm to growing plants. These experiments, however, were not carried out in soils, but under the rather artificial conditions of water or sand cultures, and while the results are of scientific interest, they cannot be directly applied to field conditions. Soil has a great capacity for counteracting harmful effects, and it may easily happen that a substance which is somewhat injurious in the physiological experiment behaves quite differently in the field. It is necessary, therefore, to approach the subject of fertiliser value with a perfectly open mind.

Since only one season's results are available it is not possible to discuss them in any detail, but some interesting points stand out. In the case of both muriate of ammonia and muriate of potash no signs of harmful effects corresponding with the purely laboratory experiments were seen so far as the writer is aware, but there were cases when the yield from the muriate was less than the yield from the sulphate, although there were also cases where no difference was observed between them.

The results seem to suggest that under some conditions farmers could use either the muriate or the sulphate, whichever they pleased, with a reasonable expectation of obtaining the same return; but under other conditions the sulphate would be safer. It is hoped that the experiments will be continued long enough to allow us to say just what are the conditions in which the two manures act alike, and under what conditions preference should be given to the sulphate. The writer would appreciate any records from farmers who have had experience with both types of fertilisers.

Effect of the Manuring of Grassland on the Yield of Milk.—An experiment made more than ten years ago at the Midland Agricultural College, and afterwards repeated at the Harper Adams Agricultural College, deserves to be brought again to the notice of dairy farmers, and might well be repeated as a demonstration at other centres. Part of a pasture field was dressed with fertiliser and part left unmanured: the plots were completely fenced in and cows were grazed on them. At the Midland Agricultural College the experiment was begun by Mr. J. F. Blackshaw and continued for three years, records being kept of the quantity and, over a considerable period, of the composition of the milk. The fertiliser used was a single dressing of 4 cwt. superphosphate and 1½ cwt. sulphate of potash per acre. The results when worked out as gallons of milk per acre are as follows:—

	Yield on unmanured plot. gal. per acre.	*Yield on manured plot.* gal. per acre.	*Increased yield due to manure.* gal. per acre.
1st year ...	136	220	84
2nd year ...	164	250	86
3rd year ...	137	218	81

In the fourth year the increased yield was 119 gal. per acre.

Even at the pre-war price of milk (6d. per gal.) the whole cost of the manure was paid off in the first year, and there was a balance on the farmers' side, while the whole of the increased yields in the 2nd and 3rd years were clear profit.

Analyses of the milk by Mr. Golding showed, as the result of manuring, a large increase in the total amount of butter fat, but a slight falling off in the percentage, and no appreciable change in the percentage of other constituents of the milk, though of course an increase in the total amounts.

The Harper Adams experiments were on slightly different lines, there being three plots—one unmanured, one receiving superphosphate only (2½ cwt. per acre), and the third receiving superphosphate (2½ cwt. per acre) and potash (½ cwt. sulphate of potash per acre). The average yields of milk for the three years summer grazing (20 weeks) were :—

Yield on unmanured plot. gal. per acre.	*Yield from superphosphate only.* gal. per acre.	*Yield from superphosphate. + potash.* gal. per acre.
175	208	212

Again a distinctly profitable increase from the use of fertilisers.*

Use of Lime on Corn Crops in which Clover is to be Sown.—A correspondent raises the question whether lime should be applied to a corn crop in which clover is to be sown, when there is reason to expect a deficiency of lime in the soil. This should certainly be done. Cases are constantly being brought to the writer's notice of failure of clover, either in patches or over a large part of the field, owing to shortage of lime. Typical instances are as follows :—

	Herts.	*Suffolk.*	*Norfolk.*
On the good parts ...	0·2	0·8	0·6 per cent. of calcium carbonate
On the bad patches ...	0·01	0·07	0·2 „ „ „ „

The correspondent further asks whether hydrate of lime would be a suitable substance for the purpose. It would. He should, however, obtain quotations for ground limestone, which would also be suitable : it is too late now for quicklime. In comparing prices it should be remembered that 100 lb. of ground limestone has the same effect as 74 lb. of hydrate of lime, and therefore it should be correspondingly cheaper.

* The results of these experiments are also discussed together with those obtained in experiments in Ireland in *Miscellaneous Publication* No. 30, pp. 6, 7, 8, 19, 20, 21.

Official Seed Testing Station.

WITH the passing of the Seeds Act, 1920, the direct control of the Official Seed Testing Station was delegated by the Ministry to the Council of the National Institute of Agricultural Botany, Cambridge. The Annual Report of the Official Seed Testing Station for the season 1920-21 is being published by the Institute and will shortly be obtainable at a nominal charge on application to the Secretary of the Institute, Huntingdon Road, Cambridge.

The following notes summarise the results of the past season's work, and indicate the nature of the subjects dealt with in the Report.

(1) The number of samples tested during the season 1920-21 was 23,577, an increase of 3 per cent. on the previous season's total. This is exclusive of about 1,500 samples of packet seeds tested on behalf of the Seed Control Branch of the Ministry.

(2) The number of farmers' samples received is still very low, only 750 farmers having sent seed for test. In any county the number of farmers utilising the Station appears to be in direct proportion to the activity in this direction of the County Organiser.

(3) The quality of seeds tested was on the whole good. In most cases the germination average is lower than that of the previous season, but this was mainly due to the indifferent harvest conditions in 1920. There was a most marked improvement, however, in the purity of clover and grass samples. With the exception of meadow fescue, all clovers and grasses showed increased purity figures. The following table shows the average yearly figures for all clovers and grasses scheduled in the Testing of Seeds Order:—

	Clovers.		*Grasses.*	
	Percentage Purity.	Percentage Germination.	Percentage Purity.	Percentage Germination.
1917-18	95·9	68·8	97·3	74·2
1918-19	95·7	78·8	97·8	82·1
1919-20	95·5	82·5	98·0	83·5
1920-21	96·6	80·6	98·1	81·9

(4) Great trouble was again experienced with delayed germinations of cereals due to incomplete after-ripening. It may be added that the favourable harvest weather of 1921 has to a great extent prevented a repetition of this difficulty during the current season.

(5) The improvement in the figures for the dodder content of clovers reported last season is maintained. Nevertheless,

nearly 20 per cent. of the samples of red clover received at the Station contained seeds of this parasite. About 4 per cent. of English red clovers contained dodder, and it is worthy of note that the large seeded form occurred almost as frequently as the small seeded "English" dodder.

(6) All varieties of clover of Czecho-Slovak origin continue to show high percentages of weed seeds and dodder.

(7) A large number of tests were made on species not scheduled in the Testing of Seeds Order, and it is satisfactory to note that such seed was found to be of good quality.

(8) Opportunity might here be taken to draw attention to two modifications in Seed Testing practice brought about by the passing of the Seeds Act.

(*a*) Since 1st August, 1921, the Continental method of testing grass seed has replaced the Irish method. The general tendency of this change is to reduce the average purity figure and to increase the average germination. This difference must be borne in mind when comparing the results of tests made since 1st August with those of tests made previous to that date.

(*b*) The germination of mangolds and beet is now estimated in terms of "germinating clusters," and not, as hitherto, in terms of "sprouts." In view of this, the "minimum percentages of germination" for these species have been reduced from 120 per cent. and 90 per cent. to 60 per cent. and 50 per cent. respectively.

* * * * * *

The Annual Report of the Chief Veterinary Officer for 1920.

This Report, being the first Report with regard to diseases of animals since the Animals Division of the Ministry was reorganised at the end of 1919, has now been issued over the signature of Sir Stewart Stockman, the Chief Veterinary Officer. It contains particulars of the various outbreaks of foot-and-mouth disease, swine fever, anthrax, parasitic mange, sheep scab, glanders and other diseases prevalent in farm animals, and the work of the Diseases of Animals Branch in connection with them. It also contains particulars of administrative action in regard to the exportation of horses, the importation of dogs, and the landing of animals from Ireland, as well as an account of the steps taken during the year 1920 in regard to importations under the Foreign Hay and Straw Orders, and the weighing of cattle under the Markets and Fairs (Weighing of Cattle) Acts, 1887 and 1891.

The Report also deals with such interesting topics as the outbreak of cattle plague in Belgium which took place in 1920,

the proceedings at the Ministry's Cattle Testing Station at Pirbright, where cattle intended for export are tested for tuberculosis, or immunised against red water prior to export to South America, East Africa, etc., and also gives an account of the work carried out at the Ministry's laboratory. Under the latter heading, no less than 4,052 specimens were examined for the purposes of diagnosis of scheduled diseases, and 235 others for non-scheduled diseases, and 913 litres of anti-swine-fever serum were prepared during the year, and 390 litres distributed for use in outbreaks during the same period. In regard to vaccination against epizootic bovine abortion, 24,520 lb. of vaccine were prepared and distributed for the inoculation of animals in affected herds.

The Report is published by H.M. Stationery Office, and is to be purchased through any bookseller, or direct from the Stationery Office, price 2s. 6d.

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Investigations into Silver Leaf Disease.

THE havoc wrought by Silver Leaf disease in plum growing districts is unfortunately only too well known to growers. The fungus has killed thousands of trees and has rendered it almost impossible for growers to cultivate Victoria and Czar plums in some districts. It is not too much to say that unless some adequate measures of control are adopted, the very existence of the plum growing industry in this country is threatened. The damage caused by the disease, however, is by no means confined to the plum. Mr. F. T. Brooks of Cambridge has recently reported that the fungus is now attacking apple trees, particularly Early Victoria, Lord Grosvenor, Lord Suffield and Newton Wonder. Mr. Brooks also states that he has found the disease on pear trees, which had hitherto been considered to be immune from attack.

For some years past, Mr. Brooks has been carrying out investigations into the disease, and more recently in conjunction with Mr. Hatton, the Director of the East Malling Research Station, has been undertaking experiments to determine the relative susceptibility of the common varieties of plum when worked on different stocks. It will necessarily be some few years before any definite results can be obtained from these experiments, but from observations made in orchards, it does appear that the stock is capable of influencing the tree to a marked degree. One case which came under observation in a Huntingdonshire orchard is particularly convincing. This orchard is

fully planted with Victorias, of which the majority are worked in the usual way on the Myrobalan stock; these are considerably infected. The remaining trees have been worked on another stock (probably the common plum), in such a way that most of the trunk of the tree belongs to the stock. The habit of growth of these trees appears to have changed very considerably, and apparently they are highly resistant. Further inoculation experiments made by Mr. Brooks have shown, that while the Pershore variety can be readily infected with the disease, there is a high percentage of natural recovery. The results of these experiments are very encouraging.

Mr. Brooks sounds a note of warning with regard to the propagation of plum trees. He has noticed cases in which silvered suckers have been used for propagation, and as he rightly points out, trees raised from diseased suckers are doomed from the commencement.

As regards methods of control, Mr. Brooks is convinced that the adoption of a proper system of plant sanitation, the importance of which cannot be over-estimated, is undoubtedly effective. Infected wood and all dead wood must be cut out and burned without delay, and the wounds thereby made must be protected immediately by a covering of grafting wax, tar, or similar material. Apart from the removal of diseased and dead wood, the less plum trees are cut about the better. It does not suffice, however, merely to burn the infected material cut from the fruit trees. Careful attention must also be devoted to those non-fruiting trees in the vicinity of plum plantations on which the fructifications of the fungus are commonly found. It should be remembered that Poplar trees, which are often planted as a wind screen, are susceptible to Silver Leaf disease when cut back, and that their dead stumps often constitute centres of infection.

All growers of fruit trees are strongly recommended to take action on the lines indicated above.

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Immunity Trials of Potatoes, 1921.

THE Potato Immunity Trials were continued in 1921 at the Potato Testing Station of the National Institute of Agricultural Botany at Ormskirk, Lancashire. The tests were carried out by Mr. H. Bryan, B.Sc., Superintendent of the Station, on lines laid down by the Ministry.

The season generally was peculiar because of the continued drought and the excessive heat, and

it soon became apparent that the varieties of potatoes would behave in a most abnormal manner. Varieties usually producing kidney-shaped potatoes tended to give ovals instead, while the oval varieties tended to yield rounds; the plants produced much secondary growth of the haulms; the first-formed tubers, even when quite small, sent out sprouts of considerable length. All the peculiarities due to the abnormal conditions had to be sifted out by Mr. Bryan before any true characteristics of the varieties could be determined and recorded, and for this work great ingenuity and patience were required on the part of the recorder. The main object of the trials was to provide a test from the results of which the Ministry would be able to decide as to the further varieties to be added to the list of Approved Immune Varieties for the purpose of the Wart Disease of Potatoes Order of 1919. It will be remembered that varieties are not added to the list until the Ministry is satisfied that they have successfully undergone a thorough test conducted on scientific lines. Generally one year's test must be considered insufficient for the results to be interpreted with accuracy; and decisions are given after the varieties have successfully passed through two consecutive tests, provided the weather during these years is normal in character.

The trials in 1921 were affected by the abnormal weather conditions to such an extent that, save in the case of a few varieties, no dependable interpretation of the results could be made, and the tests for most varieties will therefore need to be repeated in 1922. The Ministry regrets the unavoidable inconvenience that this may cause to breeders and raisers; but experiments in past years have definitely shown that the intensity of the disease is largely influenced by the amount of rainfall, and as this was but 6 inches during the months of June, July, and August, one would not expect to find much disease on any of the susceptible varieties, so that its absence could not be taken as proof of immunity.

The arrangement of the trials adopted in previous years was slightly modified, the different sections of the trials being arranged in proper groups. In the Immunity Trials there were 782 plots, of which 96 were being tested for the second time and 686 were being tested for the first time. Amongst those being tested for the second time, wart disease appeared late in the season in 9 varieties (Restorator, Ben Venue, Ben Lawers, Godolphin, Geante Sans Pareille, Seedling B.5, Seedling B.6,

Purple Eye No. 5, Seedling 105), and these for the future will be regarded as susceptible varieties. No wart disease occurred on 41 kinds, but the Ministry was able to make a definite declaration of immunity in the case of the following five varieties only:—Dunvegan, Ranfurly Red, The Celt, Barley Bounty, and G.10. The first four are listed as Approved Immune Varieties and G.10 can be listed when properly named by the introducer. A number (21) of American varieties of potatoes were included in these trials, and also in the trials of the Scotch Board's Station. No disease was seen on any of these varieties, but as the majority will probably not be introduced to the British potato-growing industry, it is not proposed unduly to lengthen the immune variety list by adding all these names *en bloc*. Should, however, the sender wish to introduce any of these varieties the Ministry would be prepared to list any distinct varieties that have successfully passed the tests. It is interesting to note that varieties which have proved immune in America have also remained immune when tested in this country, a fact which shows that the immunity of potatoes from wart disease is not an unstable character.

There were tested for the second time a number of varieties whose immunity must still remain doubtful; of these Ben Lomond and Ben Arthur are typical examples.

Of the many (686) varieties included in the test for the first time, a number (138) definitely contracted Wart Disease late in the season. Many proved synonymous with existing varieties and are referred to in the Report of the Synonym Committee of the National Institute of Agricultural Botany for 1921, but the following distinct varieties may now be definitely classed as susceptible:—

King Victor.	Guardian.	Farmer.
Vitality.	Jupiter.	Rouge de Soissinaise.
Improved Regent.	Grigor's Seedling.	Reed Major.
Craigend Abundance.	Esbie Selection.	Cornicubia.
Scarlet Marvel.	Geante Bleue.	

Of the number that remained free from wart disease, a large percentage were distinct and new to the Station. As previously stated, the test last season was by no means severe, and it is probable that a number in this group will prove susceptible when the test is repeated under more normal conditions.

A few of the stocks sent in were so mixed that it was impossible to select the plants which represented the true variety; the growth of other stocks, generally English and

Welsh, or Australian seed, was so weak that no proper records could be obtained.

In addition to the Immunity Trials proper, the Ministry, in continuance of its past policy, again accepted small quantities of seedlings from breeders for testing to provide quick information as to the susceptible ones.

* * * * * *

Prosecutions under Foot-and-Mouth Disease Orders.—A case was heard at the Bromley Police Court on 9th January, arising out of the Order of the Minister of Agriculture prohibiting the movement of animals in a part of Kent on account of the recent outbreak of foot-and-mouth disease at Sevenoaks. Two bullocks and 11 sheep had been sent by railway from Islington Cattle Market to Beckenham Station, and thence to the premises of a Beckenham butcher, thus being moved by road in the prohibited area contrary to the Order.

The Kent County Council instituted proceedings against the owner of the animals, and also the two railway companies who accepted the animals for conveyance to a destination within the prohibited area. Convictions were obtained, and the owner was fined £10 and £2 2s. costs, and the railway companies £10 and £5 respectively with £2 2s. costs in each case.

Whenever a case of foot-and-mouth disease occurs, and an Order prohibiting the movement of animals is made, the Order is at once published, and all the railway companies and other persons directly concerned are notified in order to stop the movement of animals in the locality at the earliest possible moment. This is essential to prevent the risk of a widespread dissemination of the disease, and stockowners or other persons who break the regulations bear a grave responsibility in view of the disastrous results which might follow from their actions.

At Middlesboro Police Court on 10th February, two offenders were prosecuted for neglecting to deliver up movement licences for pigs and cattle, and were fined £5 and £10 respectively, with costs in each case. All movement licences granted under the Foot-and-Mouth Disease Orders are required to be delivered up to the local police after the movement is completed. Unless this is done the authorities would not be able to maintain proper check on the movements in a scheduled area.

Eradication of Rabies in Great Britain.—By an Order which was made by the Ministry on 30th January, the remaining muzzling and movement restrictions imposed in great Britain on account of rabies, viz., those in force in Hampshire and Wiltshire, were finally removed as from 6th February, no case of rabies having occurred in those areas, nor in any other part of Great Britain, since 7th June, 1921.

In view of the freedom of the whole country from rabies for a period of eight months, the Ministry has every reason to believe that the disease has been entirely eradicated. After 16 years of freedom from rabies in the United Kingdom, the disease was re-introduced at Plymouth in the summer of 1918

by an imported dog, which, owing to the abnormal conditions arising from the War, escaped the Quarantine Regulations. This case was directly responsible for 129 cases of rabies between Devon and Cornwall before the disease was finally eradicated from those counties in August, 1919. The risk of re-importing rabies was increased during the period of demobilisation following the armistice, when, in spite of Army, Navy and Air Force regulations forbidding importation by members of His Majesty's Forces except under quarantine conditions, dogs were undoubtedly landed illegally. Some of these were detected and the offender dealt with. To such cases must be attributed the invasions of rabies in South Wales in March, 1919, in the Metropolitan area in April, 1919, in North Essex in August, 1919, and in Wiltshire extending into Hampshire and Dorsetshire in July, 1920.

Seventeen counties—all in the South of England or South Wales—were affected by the disease during the period from 1918 to 1921 (inclusive). The total number of confirmed cases of rabies was 319, but the number of reported cases investigated by the Ministry was 908. The total number of persons known to have been bitten by affected or suspected dogs was 236; of this number, 87 were bitten by rabid dogs and 123 underwent Pasteur treatment, by arrangement with the Ministry of Health, in Paris, Plymouth or London. None of these cases were known to have developed hydrophobia.

The method adopted by the Ministry in dealing with the disease may be summarised as follows :—

(*a*) Notification of suspected cases by telegram to the Ministry. Diagnostic inquiry at the Ministry's laboratory by examination of the head and neck of suspected animals.

(*b*) Immediate local inquiry by inspectors of the Ministry and Local Authority into the history of affected dogs and all contacts; particulars of persons bitten being sent at once to the Ministry of Health for action.

(*c*) On confirmation of a case of rabies, an Order is immediately applied by the Ministry to an area of about 15 to 20 miles radius around the place where the affected dog was found, requiring the muzzling of all dogs in public places and prohibiting the movement of all dogs out of that area except by licence and under quarantine conditions.

The consistent pursuit of this policy of muzzling and movement restrictions, involves considerable work; 18,053 licences were issued authorising the movement of dogs under these regulations. There is no doubt, however, that the control exercised by the Ministry has been justified by its success.

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No. 20.	Seed Testing during 1919-20. Third Annual Report of the Official Seed Testing Station of the Ministry ...	Feb., 1921

* Out of print.

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NOTE.—References to Insects, &c., and Fungi are indexed under the headings "Insects, &c.," and "Fungi" only, to Weeds under the heading "Weeds" only, to Fruit under the heading "Fruit" only, and to Diseases of Animals under "Diseases of Animals" only.

Articles or reports on the following subjects have appeared in the *Journal* each month or from time to time, and are not separately indexed:—Notes on Feeding Stuffs, Notes on Manures, Notes on Agriculture Abroad, Outbreaks under the Diseases of Animals Acts, Lists of Additions to the Ministry's Library, and Selected Contents of Periodicals.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

BREEDERS' ANNOUNCEMENTS.

CATTLE.

ABERDEEN—ANGUS.

MACAINSH, JOHN, ongash, Grantown-on-Spey, N.B.—Pure-bred Aberdeen-Angus Cattle.—Particulars on application.

DEVONS.

STANTON, HARWICH.—REGISTERED HERD RED DEVON DAIRY CATTLE. Devons are the best English Dairy Cattle under all conditions and in any climate.

FRIESIANS.

GILSTON PARK HERD OF PEDIGREE BRITISH FRIESIANS, property of A. S. BOWLBY, Esq. Bulls and Bull Calves generally for sale, by imported and other leading sires.—Apply Captain S. E. BUCKLEY, M.C., Gilston Park Estate Office, Harlow, Essex.

ROUGH HERD OF BRITISH FRIESIANS is the herd for production, colour, size, milk and butter-fat. The herd to buy your next bull calf sired by Routh Victory, third prize Dairy Show, 1920, weighing 13½ cwt. at 20 months old, whose dam gave 2,268 gallons, butter-fat 4·66 : the only cow in the kingdom to produce 1,200 lb. of butter in 365 days. Inspection invited.—P. FORD, Molescroft, Beverley.

SHORTHORNS.

WELBECK HERD OF PEDIGREE SHORTHORNS, the property of the Duke of PORTLAND, K.G. Young Bulls and Heifers for sale, from the best strains.—Apply, ALEX. GALBRAITH, Norton, Cuckney, Mansfield.

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CHIVERS & SONS, LTD., HISTON, CAMBS.—Pedigree Dairy Shorthorns. Over 100 head, mainly fashionably bred Bates Families. Milk recorded daily and checked by Ministry of Agriculture recorder. Champion Cow, reserve champion Bull, 100 Guinea Challenge Cup, R.A.S.E., Derby, 1921, etc. Bulls and Bull calves always for sale.

LINCOLN RED SHORTHORNS.

CORER, CHARLES E., BRACEBRIDGE HEATH, LINCOLN.—Lincoln Red Dairy Shorthorns. Prizes won in 1921; 2nd Breed Milking Trials, 3rd Open Butter Test (open to all breeds) Royal. Average yield 1907 to 1914, 805 galls.; 1920–21, 821 galls. Official records kept. Young bulls from proved dairy cows on sale.

THE STAPLEFORD PARK HERD. A few young Bulls from Royal Prize Winners always for sale from carefully tested milking strains only. Apply C. S. Harvey, Wymondham, Oakham.

KERRY AND DEXTERS.

PALMER, R. E. Pure Pedigree Kerry Cattle, Oaklands Park, Newdigate, Surrey.

HEREFORDS.

WHITE, W. J. S., ZEALS, WILTS.—Old-established Herd of Milking Herefords, Bulls and Calves, for Sale.

SHEEP.

OXFORD DOWN.

AKERS & CO., BLACK BOURTON, OXON.—Registered Oxford Downs, Rams and Ewe Lambs on Sale; inspection invited.

LINCOLN LONGWOOL.

HOYLES, GEO., SKIDBY MANOR, near HULL.—Pure Lincoln Longwool Sheep; true-type, sound conditions, lustrous long wool, give satisfaction at home and abroad.

SUFFOLKS.

SHERWOOD, S. R., PLAYFORD, IPSWICH.—Registered Flock 105. Holder of Bristol Champion Challenge Cup for Best Flock of the Breed, 1899 and 1919. Highest awards, Carcase Competition, Smithfield Club Show. Large winner at Royal and County Shows. Also Breeder of Pedigree Dairy Shorthorns.